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Master Thesis

Liquid Fixed Income Absolute Return Strategies

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Appendix 02:

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Appendix 03:

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Master's Thesis: Liquid Fixed Income Absolute Return Strategies

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Management Summary

With interest rates being at a historical low, investors are looking for alternatives to bond investing, which are not only richer in profits but also appropriate in risks. In their theoretical construction, absolute return strategies qualify as a possible solution, as their structure allows for delivering positive returns at any time, without taking higher risks. In recent years, absolute return strategies have been increasingly applied in the areas of equities, commodities and foreign exchange, but to a lower extent in fixed income. Therefore, this study has mainly consisted in elaborating possible fixed income absolute return strategies, based on sovereign bond futures of different maturities and currencies and traded according to the investment styles carry, momentum and value within both a directional and cross-asset setting. These investment styles have been applied in isolation and in conjunction, under both a decreasing and increasing interest rate environment. This was done with the aim of identifying whether long/short strategies based on these investment styles are likely to outperform a passive long-only strategy independent of the economic environment. Overall, evidence has been found for directional carry- and value-based strategies on one hand, and a cross-sectional carry trade strategy on the other hand, to do so over decreasing and increasing interest rate periods respectively. While directional strategies consist in trading all considered futures equally, the latter strategy consists in being exposed only to the top (bottom) quartile sovereign bond futures and only if their carries are positive (negative). Nevertheless, performances over both decreasing and increasing interest rate periods are found to be only partially significant at the 90% level. Furthermore, as soon as the portfolios are charged with costs of one basis point per trade, only the directional value portfolio still outperforms over the respective periods. This study further tested macroeconomic information and residuals from a treasury rate-based Principal Component Analysis as potential triggers for trading. Among the former, it has analyzed the federal funds future as a predictor of future US cash rate shifts, inflation expectations implied in treasury inflation protected securities and inflation swaps, cash rate and quantitative easing decisions on behalf of several central banks, as well as economic activity and inflation measures from government reports. Overall, the study has found only cash rate decisions trading to be favorable, but only when trading the three-month future. Only latter information source results in statistically significant as well as higher performances than that of a respective long investment. Furthermore, a risk assessment of the created absolute return funds was conducted by building US and German yield curve scenarios and correspondingly accounting for the portfolio sensitivities. Scenarios have been constructed with help of a factor-based scenario method, which consists in applying positive and/or negative shocks of different sizes to the level and slope of the yield curves. Long/short strategies are found to be less negatively (positively) impacted by unfavorable (favorable) changes in the yield curve than the long-only strategy. Further, simultaneous positive shocks on the level and the slope are found to have the most negative effect on the portfolios values.

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Index of Abbreviations

APF	Asset Purchase Facility
ABS	Asset Backed Securities
ABSPP	Asset Backed Securities Purchase Programme
APP	Asset Purchase Programme
BOE	Bank of England
BOJ	Bank of Japan
B&H	Buy-and-Hold
CBOT	Chicago Board of Trade
CBPP	Covered Bond Purchase Programme
CDS	Credit Default Swap
CPI	Consumer Price Index
CSM	Cross-Sectional Momentum
CSPP	Corporate Sector Purchase Programme
CSV	Cross-Sectional Value
CTA	Commodity Trading Advisor
ECB	European Central Bank
EMA	Exponentially Moving Average
FED	Federal Reserve
FOMC	Federal Open Market Committee
GDP	Gross Domestic Product
JGB	Japanese Government Bond
LMA	Linear Moving Average
LSAP	Large Asset Purchase Programme
LTRO	Long-Term Refinancing Operation
MBS	Mortgage Backed Securities
MRO	Main Refinancing Operations
NAPM	National Association of Purchasing Managers
OIS	Overnight Index Swap
OMT	Outright Monetary Transactions
OTC	Over The Counter
PCA	Principal Component Analysis
PPI	Producer Price Index
PSPP	Public Sector Purchase Programme
P&L	Profit and Loss
QE	Quantitative Easing
RBA	Reserve Bank of Australia
SMA	Simple Moving Average

SMP	Securities Market Programme
TIPS	Treasury Inflation Protected Securities
TLTRO	Targeted Long-Term Refinancing Operation
TSC	Time-Serial Carry
TSM	Time-Serial Momentum
TSV	Time-Serial Value
VaR	Value at Risk
YTM	Yield-To-Maturity
1. CSC	First Cross-Sectional Carry
2. CSC	Second Cross-Sectional Carry

Bloomberg Tickers

EUR003M Index	Euribor 3-month Rate
GDBR2 Index	German 2-year Treasury Note Rate
GDBR5 Index	German 5-year Treasury Note Rate
GDBR10 Index	German 10-year Treasury Note Rate
GDBR30 Index	German 30-year Treasury Bond Rate
US0003M Index	US 3-month Treasury Bill Rate
USGG2YR Index	US 2-year Treasury Note Rate
USGG5YR Index	US 5-year Treasury Note Rate
USGG10YR Index	US 10-year Treasury Note Rate
USGG30YR Index	US 30-year Treasury Bond Rate
ER1 Comdty	Euribor 3-month Future
DU1 Comdty	Euro-Schatz 2-year Future
OE1 Comdty	Euro-Bobl 5-year Future
RX1 Comdty	Euro-Bund 10-year Future
UB1 Comdty	Euro-Buxl 30-year Future
FF1 Comdty	30-days Fed Funds Future
ED1 Comdty	Eurodollar Future CME
TU1 Comdty	US 2-year Treasury Note Future
FV1 Comdty	US 5-year Treasury Note Future
TY1 Comdty	US 10-year Treasury Note Future
US1 Comdty	US 30-year Treasury Bond Future
IR1 Comdty	Australian 3-month Treasury Bill Future
XM1 Comdty	Australian 10-year Treasury Note Future
YE1 Comdty	Euroyen Tibor 3-month Future
JB1 Comdty	Japanese 10-year Treasury Note Future
G 1 Comdty	Long Gilt Future

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1. Introduction

1.1. Problem Statement

After three decades of steadily decreasing interest rates and increasing bond prices, today interest rates are at a historical low, representing uncommonly low risk/reward ratios. As a countermeasure to today's low-interest rate environment, investors, especially institutional investors, are increasingly considering to reinvest or shift their existing fixed income investments into so-called absolute return strategies. Latter are constructed in a way that investors can profit from both stable returns independent of the economic situation and a diversification source due to its low correlation to interest rates and traditional asset classes (Macintosh, n.d.). Absolute return strategies are increasingly gaining in importance because investments in such are favoured precisely by those environmental factors, which mainly challenge the investment in long-only fixed investment strategies. To date, absolute return strategies have been applied in the sectors of equities, currencies, commodities, but less in the area of fixed income (Aronov & Eigen, 2015, p. 1). The still incipient area of fixed income absolute return investments invites to look for possible strategies that enable excess returns over long-only bond investments.

1.2. Objective

This study aims to examine whether liquid fixed income absolute return portfolios based on the investment styles carry, momentum and/or value, and composed of sovereign bond futures of different tenors and currencies are able to outperform an equally weighted buy-and-hold portfolio composed of the same futures. Based on historical data, it will be shown whether long/short investment strategies are able to outperform a passive long-only investment strategy at any time and under both decreasing and increasing interest rate environments. The study further examines macroeconomic information arising from financial markets and periodic reports, as well as results from a Principal Component Analysis (PCA) as potential triggers for trading. For this examination, the study considers only macroeconomic variables that according to literature have been proved to successfully predict changes in the yield curve. Besides being useful as trading signals, the elements of the PCA serve as parameters for the construction of prospective scenarios. Latter are developed with help of a factor-based scenario method. The scenarios aim to illustrate how long/short portfolios may behave under different interest rate environments. They will show how the performances of long/short portfolios may be affected by sudden changes in the yield curve and whether the encountered downward risk is lower than for a long-only strategy.

The study is geared toward both private and institutional investors. The absolute return portfolios elaborated in this study are to be regarded in isolation and therefore detached from any existing investments. The whole work is supervised by Prof. Dr Peter Schwendner, senior lecturer

for Asset Management and Risk Management at the Zurich University of Applied Sciences (ZHAW).

1.3. Structure

After a short illustration of the problem, the first chapter points out the objective and provides an overview of the overall data and methodology applied, as well as the most important delimitations of the study. As the sub-studies differ in the data and methodologies they are based on, latter are described in more detail in the introduction of each section. In the sequel, the second chapter introduces some essentials about absolute return strategies in fixed income and provides a literature review of the fundamentals of this study. More precisely, it provides a theoretical overview as well as an insight into the research conducted so far in the areas of the investment styles carry, value and momentum, the use of PCA analysis for trading purposes, the creation of prospective scenarios with help of PCA, the common factors influencing the yield curve, the effect of macroeconomic variable announcements on bond futures' prices and the effectiveness of market implied inflation and monetary policy information for trading purposes. These reviews focus solely on the research done so far in the area of fixed income. From here on, under investment styles are meant strategies based on carry, momentum or value. The goal of chapter 3 is to illustrate how bond futures may react under different interest rate environments and yield curve structures, how the long/short portfolios were constructed and managed, which portfolios perform best under a decreasing and increasing interest rate environment, as well as what further trading tools are suitable as trading triggers. First of all, it describes what data the investment styles analysis was based on, how the portfolio components were traded and weighted, and what the results of the analysis are. Second, it illustrates what further information was tested as potential trading indicators, how they were tested and what the results are therefrom. Information sources considered are inflation expectations implied in treasury inflation-protected securities (TIPS) and inflation swaps, probabilities of future monetary policy changes implied in the US federal funds future, cash rate and large asset purchase program (LSAP) decisions on behalf of central banks, announcements on macroeconomic variables and interest rate-based PCA results. Chapter 4 presents prospective interest rate scenarios constructed with help of a factor-based method. It further illustrates what impact the different scenarios may have on the value of some of the portfolios, which resulted to perform best in chapter 3. For the analysis on the investment style portfolios carry, momentum and value, this study makes use of an interim conclusion. Latter is done as the scope of the analysis requires a more detailed summary. It differs from the overall conclusion at the end of the work, which rather aims to focus on the most important findings of the whole work and provide some recommendations for further research.

1.4. Data and Methodology

Except for the examination on the probability of fed policy shifts and the effectiveness of LSAPs, this study conducts all other studies in a long/short portfolio context. This is the case for all investment styles and further information sources that are tested as potential trading triggers, like carry, momentum and value on one hand and market implied inflation information arising from break-even and inflation swap rates, cash rate decisions, macroeconomic announcements and results of interest rate-based PCAs on the other hand. Trading signals and information sources tested in a portfolio context are always compared with a passive long-only investment strategy, represented by a buy-and-hold strategy. Another commonality among the sub-studies conducted in this work is the performance computation. The portfolio performances are judged on a risk-non-adjusted and risk-adjusted basis, as well as before transaction costs. Gross returns are computed daily and discrete:

(1) $$r_{t+1}^{gross} = \left[\left(\frac{P_{t+1}}{P_t}\right) - 1\right] * S_{t-1}$$

Where P represents the price of the future to be traded and S the signal generated by the strategy/trading rule. Latter is +1 for long positions, -1 for short positions and 0 for neutral positions. The return calculation always includes a slippage of one day. This is done based on the assumption that on the day of the signal, only the allocation decision is taken, whereas the trade occurs not before the day following the allocation decision. Neutral positions are not considered throughout. Some analyses consist in the portfolio being exposed to the future at any time. Strategies that outperform the buy-and-hold strategy under a gross return criterion are further tested when accounting for transaction costs. This is done according to Park & Irwin (2005):

(2) $$r_{t+1}^{net} = r_{t+1}^{gross} + d_{t+1}\left(\frac{n_k}{N_k^{in}}\right)\ln(1-c)$$

Where d equals +1 on days where it is invested in the respective future and 0 when it is not. In the analyses where neutral positions are not considered, d never equals 0. n_k and N_k^{in} stand for the total number of round trades and the total number of days of exposure respectively (p. 4). Lastly, c stands for the transaction costs per trade. In this work, costs per trade take on the sizes of 0,01%, 0,02% and 0,03% of the volume traded. As the size of the transaction costs is dependent on the trading time and the type of investor, it seems legitimate not to account for one single rate only, but rather a range. Therefore, doing so helps to account not only for the sensitivity of performances on transaction costs in a better way, but also to reflect the cost-adjusted performances for different investors. All portfolio returns are subject to a parameter stability test called “White reality check” which allows for judging to what extent the overall portfolio performance arises due to luck, and to which other extent it is a result of the signals traded upon. The technicals underlying the White reality check are illustrated on pages 86 to 88. The sub-studies further differ from each other in the time-periods and instruments they were tested for.

For instance, even though within most studies the trading signals were tested for their effectiveness across both short- and long-term periods, and in most cases the analyses consisted of both an in- and out-of-sample, the widths, instants of time and underlying instruments differ throughout. Data is collected on a daily basis for the US, the European Union, Australia, Japan and the United Kingdom over the period ranging between January 5, 1999 and March 3, 2017. Data on sovereign treasury rates, treasury futures, inflation swap rates, TIPS, economic growth variables, inflation variables, as well as on corporate credit indices, latter being used as proxies for a country's credit risk, are gathered from the Bloomberg database. On the other hand, information on cash rate and LSAP decisions on behalf of the Federal Reserve (Fed), European Central Bank (ECB), Reserve Bank of Australia (RBA), Bank of Japan (BOJ) and Bank of England (BOE) are extracted directly from the central banks' monetary policy statements. It shall be noted that for the European Union, treasury rates are proxied by rates on German treasury bills, notes and bonds. More detailed information on the approach and data underlying each sub-study can be taken from the respective introduction.

1.5. Delimitations

The portfolios include exclusively short-, mid- and long-term sovereign bond futures with maturities ranging from three months to two, five, ten and thirty years. Neither corporate bond nor money market futures are considered. Overnight treasury futures are not considered when analyzing the investment styles long/short portfolios, as the inclusion of such would imply a massive weight, resulting in an underinvestment in futures of larger maturities. One major challenge is the lack of data under a rising interest rate environment, as since data on sovereign bond futures are available, interest rates have mainly decreased. However, this is counteracted by inverting data collected over decreasing interest rate periods. Furthermore, market implied inflation rates are computed through TIPS and inflation swaps only. Other sources such as survey or inflation options are neglected. The most important delimitation of this study is the lack of data on the three-month Australian t-bill rate. This concern is of relevance for the construction of the investment styles long/short portfolios over the in-sample, as no data is available for that period. However, this issue can be counteracted easily by excluding the instrument from the portfolios during that period, as well as across short-term periods falling in such. This issue does not result to be problematic, as the aim of the analysis is to compare the long/short strategies with each other and with the buy-and-hold strategy under different interest rate environments, but not through time. Lastly, while for the US, European area, Australian and Japan market it is tested for the interrelation between quantitative easing (QE) announcements, treasury rates and credit risk, for the United Kingdom it cannot be accounted for latter as the data is available neither for sovereign nor for corporate credit spreads.

2. Fixed Income Absolute Return Strategies

Unlike passive long-only strategies, whose idea consists in the purchase of assets and just hoping that the portfolio provides an excess return over a determined benchmark, absolute return strategies rather aim to realize positive performances regardless the development of the market through both long and short positions. Managers of absolute return strategies apply relative value techniques by actively investing long and short in market opportunities and threats (Blackrock, n.d., p. 1). In fixed income absolute return strategies, long investments may be done in fixed income instruments of different types and risk-shapes, while short selling is conducted especially through derivatives such as futures or credit default swaps (Johnson, 2015, p. 2). Unlike benchmark-based strategies, the size of the return is dependent to a higher extent on the trading skills of the manager (Aronov & Eigen, 2015, p. 2). In fixed income absolute return strategies, managers try to realize high returns by trading yield curves, going credit long or going credit short (Aronov & Eigen, 2015, p. 3). As within absolute return investing no benchmark is used, not only the return is absolute, but also the risk. In other words, the risk is not measured through means of tracking errors, as it is the case when applying benchmark-based strategies, but rather as the standard deviation of returns (Johnson, 2015, p. 4). With regard to the risk management, it is highly important that absolute return portfolios are constructed based on a multiple numbers of scenarios during which positive returns are achievable. In addition, it is of high importance that portfolio managers and investors understand how the portfolio may behave not only during normal, but also more stressed times (Aronov & Eigen, 2015, p. 3). Absolute return strategies, as a whole, are optimal for investors willing to preserve their capital and seeking for consistent returns, while being uncorrelated to the betas of traditional asset classes throughout (Aronov & Eigen, 2015, p. 3). Besides the non-usage of a benchmark and the aim of realizing a positive performance at any time, absolute return strategies, as a whole, are also characterized by their low correlation against traditional asset classes. Investors willing to participate in the fixed income market only can profit from several features if they invest in fixed income only absolute return strategies. Besides being able to profit from the broad diversification of such strategies, they may also benefit from the lower transaction costs and the broader liquidity they imply. Both the liquidity and the transaction costs are improved due to the more extensive usage of derivatives. Especially in the fixed income market, there is the difference in costs and liquidity between futures and their underlying instruments (Aronov & Eigen, 2015, p. 4).

Today's low levels of interest rates as well as rising volatility make absolute return strategies increasingly attractive, while bond benchmark-based strategies increasingly unattractive (Macintosh, n.d., p. 1). Therefore, it is important to provide an alternative to traditional fixed income investing for investors interested in such.

2.1. Investment Styles

The main part of this work consists of testing sovereign bond futures portfolios traded upon trend and carry signals under different interest rate environments. This is done with the aim of coming up with that investment style or a combination of several investment styles that allows for achieving the best performance independent on how interest rates move. Trend investing is done when it is believed that the past performance of an asset or asset class is representative for the future performance (Fattouche, Ghia, & Staal, 2014, p. 3). Therefore, trend-based investment styles are conducted with the aim of profiting from the persistence of single assets or asset classes over shorter or longer time horizons (Fattouche, Ghia, & Staal, 2014, p. 2). Trends typically arise due to exposures to a systematic risk, investors' behaviour and market structures. First, the risk premia underlying instruments derived from interest rates are highly subject to changes in the macroeconomic environment, such as economic growth or inflation among others. Second, trends can arise due to irrational actions of investors and market inefficiencies. An example of the former would be the so-called disposition effect, where investors are keen on selling when the asset is doing well and holding when such is doing relatively bad. Another example would be the higher attractiveness to investors recently well-performing assets have over recently worse performing ones, consequently ending in investors buying and selling the past good and bad performing assets respectively. Third, a driver of trends may be the participation of central banks in the rates market, be it through conventional tools such as open market operations, or rather unconventional approaches such as QE (Fattouche, Ghia, & Staal, 2014, p. 3). Within and after the financial crisis, the central banks' participation has however rather been disruptive for trend developments (Fattouche, Ghia, & Staal, 2014, p. 24).

The trend signals tested in this study are momentum and value. Momentum investing consists in buying (going long) high-returning assets and selling (going short) downward trending assets. Value investing consists rather in buying (going long) undervalued and selling (going short) overvalued assets. On the other hand, carry trading consists in buying (going long) an asset when its carry is positive and high, whereas selling (going short) an asset when its carry is highly negative. The purpose of carry trades is to exploit the difference between the expected price of a forward or future price and the spot price at maturity (Baz, Granger, Harvey, Le Roux and Rattray, 2015, p. 3).

2.1.1. Carry

Unlike trend investing such as through momentum or value, whose underlying ideas are relatively straightforward, carry trading needs some more explanation as the idea behind it is less trivial. Therefore, in the following, first the overall definition of carry is provided, second it is regarded what carry means in a single bond context, third in a bond futures framework and last-

ly on a whole bond futures portfolio level. Examples used for explaining the carry are based on daily observations, as this study accounts for the carry on a daily basis.

2.1.1.1. Overall Definition

The return of an asset is the sum of its expected return and an unexpected price shock, where the former in turn is the result of a carry return and an expected price appreciation. Hence, carry can be defined as the expected return of the asset, assuming there are no changes in the price (Koijen, Moskowitz, Pedersen and Vrugt, 2015, p. 1).

(3) $$\begin{aligned} return &= expected\ return + unexpected\ price\ shock \\ &= [carry + E(price\ appreciation)] + unexpected\ price\ shock \end{aligned}$$

As the carry-component of the expected return is known in advance, it is not necessary to use an estimation model for its computation. However, this would be rather necessary for the second part of the expected return, the expected price appreciation (Koijen et al., 2015, p. 1). The nature of carry can be explained by the theories of liquidity or preferred habitats, among others (Baz et al., 2015, p. 5). However, these theories are not addressed furtherly as for the purpose of this study it would be out of scope.

2.1.1.2. Carry of a Bond

When considering commodities, currencies or equities, carry is generally interpreted as the expected return, given there are no changes in the price. However, for bonds, carry is mostly defined differently because a bond's maturity changes over time. This issue is for instance of lower severity for coupon-paying than for zero-coupon bonds. If one would account for the general definition of carry, the carry of the former would equal the current yield, consisting of the ratio between the coupon and the price for the bond, while for the second it would result in a carry of zero as no coupon is paid. In order to account for the carry return also among latter, a bond's carry can, for instance, be assumed as the yield-to-maturity (YTM), which does not change over time. For illustration, assume today's price (P_t^T) of a ten-year bond paying coupons every year to be the following (Koijen, Moskowitz, Pedersen and Vrugt, 2012, p. 10):

(4) $$P_t^T = \sum_{i \in \{coupon\ dates > t\}} D(1 + y_t^T)^{-(i-T)} + \bar{P}(1 + y_t^T)^{-(T-t)}$$

Where D is the coupon, y_t^T the YTM, $\bar{P}$ the price paid back at maturity and T equals today in ten years-time.

If the YTM is assumed to be the same over time, the bond price one day later will be computed the same, but now discounting coupons and the price not from $T - t$ (10 years), but from a day less $T - t - 1$ (10 years – 1 day) (Koijen et al., 2012, p. 11).

(5) $$P_{t+1\ day}^{T-1\ day} = \sum_{i \in \{coupon\ dates > t\}} D(1 + y_t^T)^{-(i-t-1\ day)} + \bar{P}(1 + y_t^T)^{-(T-t-1\ day)}$$

Based on the price at time t (e.g. today's price) and the price at time $t + 1\ day$ (e.g. price in one day), the carry (C_t) and therefore the YTM (y_t^T) newly becomes:

(6) $$y_t^T = C_t = \frac{P_{t+1\ day}^{T-1\ day} + D * 1_{[t+1 \in \{coupon\ dates\}]} - P_t^T}{P_t^T}$$

Where $D * 1_{[t+1 \in \{coupon\ dates\}]}$ is the first coupon paid between P_t^T and $P_{t+1\ day}^{T-1\ day}$, where P_t^T equals today's price and $P_{t+1\ day}^{T-1\ day}$ the price one day after (Koijen et al., 2012, p. 11).

Another alternative to this definition of carry would be to denote the carry return as the return on the bond, assuming a constant term structure of interest rates. Therefore, the carry (C_t) would be the bond return assuming a changing YTM (Koijen et al., 2012, p. 11):

(7) $$C_t = \frac{P_{t+1\ day}^{T-1\ day} + D * 1_{[t+1 \in \{coupon\ dates\}]} - P_t^T}{P_t^T}$$

$$= y_t^T + \frac{P_{t+1\ day}^{T-1\ day}(y_t^{T-1\ day}) - P_{t+1\ day}^{T-1\ day}(y_t^T)}{P_t^T}$$

what in turn could be approximated as the difference between the YTM at time t and the modified duration of the change in YTM:

(8) $$\cong y_t^T + modified\ Duration\ (y_t^{T-1\ day} - y_t^T)$$

The carry of a bond can be thought as the sum of the bond yield and the "roll down" return, where latter is the price increase from rolling down the yield curve. Using the example of a ten-year coupon-paying bond, the price increase from today's price (P_t^T) to the price one day later ($P_{t+1\ day}^{T-1\ day}$) implies a roll-down in the yield curve as the time to maturity decreases. Latter in turn results in a negative yield change from y_t^T to $y_{t+1\ day}^{T-1\ day}$ (Koijen et al., 2012, p. 11).

While on one hand, the price of a bond appreciates (depreciates) in case of decreasing (increasing) interest rates, on the other hand, the carry depends on the slope of the yield curve (Niederhoffer & Weddepohl, 2014, p. 2). The carry and the yield curve are positively related to each other. Therefore, assuming a long position in a bond, the carry is positive (negative) whenever the yield curve is positively (negatively) sloped (Niederhoffer & Weddepohl, 2014, p. 2).

2.1.1.3. Carry of a Bond Futures Contract

As future contracts on bonds simply consist in the purchase or sell of a bond at a future point in time, the logical derivation is that also profits arising from bond futures investing depend on the development of the bond's price and the carry (Niederhoffer & Weddepohl, 2014, p. 2). However, it shall be noted that in bond future investing, carry represents the yield gained from rolling the futures contract (Niederhoffer & Weddepohl, 2014, p. 3). That is why when dealing with bond futures, carry is also called roll yield. In fact, the roll yield is nothing else than the differ-

ence between the spot and the future's return. It is not to be confused with the yield arising from rolling one future contract into the next one, but rather the yield gained from the convergence of the spot and futures prices the closer to expiry the futures contract gets. The act of rolling from one future into the other does not yield (Winton Capital Management, 2014, p. 1). Analogous to the underlying bond, while a steeper slope causes a higher positive carry when being long the bond future, the opposite is the case when being short. On the other hand, a flattening of the slope leads to a less positive carry when being long and to a less negative carry when being short (Niederhoffer & Weddepohl, 2014, p. 12).

Put differently, a bond future's carry is the return that is made over the time of the futures contract, assuming that the spot price does not change. As the future contract (F_t) expires at the spot price at time $t+1$ (S_{t+1}), and latter will equal today's spot price (S_t), carry (C_t) can be denoted as follows (Koijen et al., 2012, p. 6):

(9) $$C_t = \frac{S_t - F_t}{F_t}$$

The expected price appreciation, which as seen in the overall definition, is the second component of the expected return, can then be interpreted as the expected relative appreciation of the spot price:

(10) $$E_t\left(\frac{\Delta S_{t+1}}{F_t}\right) = E_t\left(\frac{S_{t+1} - S_t}{F_t}\right)$$

Adding the unexpected price shock to the expected return then leads to the return of the bond:

(11) $$r_{t+1} = C_t + E_t\left(\frac{\Delta S_{t+1}}{F_t}\right) + u_{t+1}$$

Where $\left[C_t + E_t\left(\frac{\Delta S_{t+1}}{F_t}\right)\right]$ stands for the expected return and u_{t+1}, also denotable as $[S_{t+1} - E_t(S_{t+1})]\,/F_t$, for the unexpected price shock (Koijen et al., 2012, p. 6).

To avoid issues of liquidity and differences in coupon sizes among bond futures contracts, the bond future carry can be computed using the term structure data, which in turn can be obtained from the cash bond markets. As illustrated above with the example of a ten-year bond paying coupons annually, the carry can be computed based on a ten-year zero-coupon bond. In fact, latter is the approach pursued in this study to come up with the carry of the sovereign bond futures, as the bond yields underlying the analyses are constant maturity zero coupon yields. As under a coupon-paying bond context, at the launch date, y_t^T would equal $y_t^{10\ years}$, and one day later $y_{t+1\ day}^{10\ years\ -\ 1\ day}$. The carry however, is then computed as follows (Koijen et al., 2015, p. 13):

(12) $$C_t = \frac{1/(1+y_t^{10\ years-1\ day})^{\frac{10\ years-1\ day}{252\ days}}}{\frac{(1+risk\ free_t)^{\frac{1}{252\ days}}}{(1+y_t^{10\ years})^{10 years}}} - 1$$

While the ten-year- and the ten-year-minus-one-day- maturity yields would be used to interpolate the yield required for each day, the three-month maturity yield would be rather used as the risk-free rate (Koijen et al., 2012, p. 32).

2.1.1.4. Carry of a Bond Futures Portfolio

After having seen the definitions for carry on bonds and bond future contracts, the carry of a bond futures portfolio ($C_t^{portfolio}$) can be computed rather easily, as the weighted sum of the single bond futures' carry returns (Koijen et al., 2015, p. 19):

(13) $$C_t^{portfolio} = \sum_i w_t^i C_t^i$$

Where C_t^i equals the carry and w_t^i the weight of the respective bond future contract. If the weights should be equal for all future contracts, then w_t^i would be computed simply by dividing one with the quantity of contracts ($\frac{1}{N}$).

2.1.2. Literature on Investment Styles

To date, several research papers have been conducted on the three investment styles - carry, momentum and value – all applicable to fixed income portfolios. In such, the three investment styles have been tested within both a cross-sectional and a time-serial framework, and generally within and across the asset classes of equities, commodities, fixed income and foreign exchange. In a portfolio management context, the terms cross-sectional and time-serial are not to be confused with the types of analysis conducted in empirical research. In an investment context, the term cross-sectional is used when the trading and weighting of assets depend on their attractiveness relative to other assets in the same portfolio, whereas time-serial is used when the trading of an asset depends solely on its own characteristics. Asness, Moskowitz and Pedersen (2013) tested value and momentum in a cross-sectional framework. Moskowitz, Ooi and Pedersen (2011) examined momentum in a time-serial context. Koijen, Moskowitz, Pedersen and Vrugt (2012 & 2015) examined carry in isolation within both a directional (time-serial) and cross-asset setting (cross-sectional). Lastly, Baz, Granger, Harvey, Le Roux and Rattray (2015) investigated all three strategies within both settings.

In more detail, Asness, Moskowitz and Pedersen (2013) focus on how cross-sectional momentum and value strategies are interrelated, not only within, but also across asset classes. They analyze equities, government bonds, currencies and commodities. Their work differs primarily from that of others, in that they emphasize the importance of value and momentum strategies when used together, and not alone. In contrast to Moskowitz, Ooi and Pedersen (2011), who

analyze time-serial momentum, Asness, Moskowitz and Pedersen (2013) focus rather on cross-sectional momentum (p. 932). They define momentum as the return over the past twelve months. However, they do not account for the most recent month, as during such, some asset classes like currencies or stocks are likely to experience reversals due to liquidity issues. By neglecting the most recent month, they can ensure the uniformity they need for comparing the results across asset classes (p. 937). Within the government bonds, the authors examine value and momentum jointly across eight different regions. They find consistent evidence that bonds' value and momentum correlate negatively (p. 930). Not only restricted to the fixed income, but for all asset classes examined, they find significant evidence for liquidity risk being negatively related to value, whereas positively to momentum (p. 931). They further find that funding risk is what primarily connects returns from value and momentum. They claim that the extent to which funding risk connects the two return sources has gained in importance increasingly since the funding crisis in 1998 (p. 931). Among their results, most remarkable is the finding that together, value and momentum are more profitable than in isolation (p. 932). More precisely, abnormal returns are substantial when value and momentum are combined and weighted equally. Weighting the two sources equally avoids that returns are prone to liquidity risk (p. 931). For their investigation they collect bond index returns, short rates, ten-year government bond yields and inflation forecasts for Australia, Canada, Denmark, Germany, Japan, Norway, Sweden, Switzerland, the United Kingdom, and the United States. The data ranges from January 1982 to July 2011, where the data is available for all of them not before 1990 (p. 935). For each asset class, the authors construct three value and three momentum portfolios based on securities being ranked into high, middle and low. For bonds, they built overall six portfolios, from which three were value-based and the other three momentum-based and whose components were equally weighted (p. 938). The results of the portfolios testing, when using the momentum measure and a five-year change in yield method of value, seem to be weak for bonds, as in contrast to equities, commodities and currencies, they do not exhibit statistically significant return premia. However, the authors claim that the bond value measures may be improved by using the alternative measures. They show that by using multiple value measures at the same time, they achieve a more reliable risk premium. The use of multiple value measures helps to reduce not only measurement error, but also noise (p. 947).

Moskowitz, Ooi and Pedersen (2011) found evidence for positive predictive power of all futures' and forwards' past returns they examined. Even though they focus on time-serial momentum, they also analyze the relationship between time-serial and cross-sectional momentum. Equal to Asness, Moskowitz and Pedersen (2013), this study was conducted not only within fixed income, but also within equities, commodities and foreign exchange (p. 1). In fixed income, they analyze data ranging between 1965 and 2009 for thirteen liquid government bond futures (p. 7). For all asset classes and every instrument they analyze, they find that the forward

contracts' twelve-month past excess return positively predicts its future return and that trends last for approximately one year, before reversing in the long-term (p. 1). However, excess returns are only significant for equities and government bond futures (p. 9). Consistent with theory, Moskowitz, Ooi and Pedersen (2011) find returns of bond future contracts to be driven in particular by positive auto-covariance (p. 3). Latter is found to drive not only time-serial momentum the most, but also cross-sectional momentum (p. 37). A decomposition of time-serial momentum into the components of spot price predictability and roll return further allowed the authors to identify that even though both components contribute to time-serial momentum profits, only changes in spot price are related to long-term reversals (p. 4).

Koijen et al. (2012) examine how the carry is related to the total expected returns on the same asset classes as Asness, Moskowitz and Pedersen (2013) and Moskowitz, Ooi and Pedersen (2011). In other words, they primarily investigate whether the carry return may predict expected price appreciation (p. 7). Equal to Moskowitz, Ooi and Pedersen (2011), they also base their investigations on futures contracts. Carry is found to positively correlate with expected returns among all asset classes. According to Koijen et al. (2012), carry can be seen as a predictor of expected returns, as both carry and expected returns vary over time (p. 3). Within fixed income, they analyse futures on the ten-year government bonds of Australia, Canada, Germany, the UK, Japan, New Zealand, Norway, Sweden, Switzerland and the US, starting from January 1995, except for Norway, whose data is available since August 1998, and ending in February 2011 (pp. 14 & 38). As bond futures are only limited to some few countries and their period length is even short, they do not collect bond futures' data at all, but rather replicate the futures returns synthetically by using ten-year, nine-year, as well as three-month constant maturity yields (p. 32). The carry is measured at each month's end and as the average of the measure during the past twelve months. According to their findings, the former performs better than a passive long investment. The excess returns (alphas) of the fixed income carry strategies when compared to the benchmark (passive long investment) are all consistently significant and positive (p. 16). Moreover, the high-annualized Sharpe ratios obtained from their analysis in the asset class of the fixed income, indicate carry and expected returns to be cross-sectional strongly connected with each other (p. 3).

The time serial returns of both measures of carry were regressed with the following factors (pp. 18 & 19):

- x_1: returns of a portfolio, whose return is the equal-weighted average of its constituents' returns
- x_2: value measure of Asness, Moskowitz and Pedersen (2013)
- x_3: cross-sectional momentum measure of Asness, Moskowitz and Pedersen (2013)
- x_4: time-serial momentum of Moskowitz, Ooi and Pedersen (2011)

With exception of the negative effect that time-serial momentum has on the carry strategy, when carry is measured at each month's end, none of the results are significant at a confidence level of 95%. On the other hand, the alpha is significant for both measures of carry (p. 42).

Baz et al. (2015) investigate the investment strategies carry, value and momentum in a directional (time-serial) and cross-asset setting. By doing so, they comprised the settings of Moskowitz, Ooi and Pedersen (2011) and Asness, Moskowitz and Pedersen (2013), whose investigations were conducted only in a time-serial and a cross-sectional context respectively. Equal to the authors of the research papers presented so far, Baz et al. (2015) base their investigations on the asset classes of equity, fixed income, commodities and currencies. They show that the three strategies are more profitable when applied together, compared to when applied in isolation (p. 2). Baz et al. (2015) base their investigations on fourteen treasury rate swap contracts based on mid-market prices and not accounting for trading costs. In a cross-sectional framework, under a risk-adjusted criterion (Sharpe Ratio) carry-only interest swap-rate based strategies perform better than either value, momentum or a combination of the three. Furthermore, they conclude that within the asset class of the fixed income, all three strategies correlate only slightly positive with each other. While value and carry correlate at a coefficient of 0,16, value and momentum correlate at a degree of 0,15 and carry and momentum at 0,01 (p. 14). Baz et al. (2015) consider strategies not only when based on the investment styles in isolation, but also when combined. They compute all strategies that are possible based on several investment styles, which are value and carry, value and momentum, carry and momentum and a combination of the three. On a risk-adjusted basis, the value-and-carry based strategy performs significantly better than all other combined strategies.

2.1.2.1. Dependence of Investment Styles on External Risk Factors

Besides examining the investment styles solely on their performance, researchers like Asness, Moskowitz and Pedersen (2013) or Koijen et al. (2012) also investigate their relation towards external macroeconomic and liquidity risk factors in order to better understand the behavior of these strategies. Asness, Moskowitz and Pedersen (2013) analyze the interrelation between value and momentum with macroeconomics among non-stock asset classes by using factors as global macroeconomic variables, such as default spreads, GDP growth, long-term consumption growth, market returns, recession and term spreads. They show that despite the negative relationship between momentum and recessions, these global macroeconomic variables are not significantly connected neither with value nor with momentum returns among non-stock assets such as government bonds. For instance, even though they find a consistent negative relationship between value returns and default spreads, these results are insignificant (p. 956). Apart from global macroeconomic risks, Asness, Moskowitz and Pedersen (2013) also investigate the impact of global liquidity risks on the investment styles momentum and value. They find a posi-

tive relation to momentum, but a negative to value. They claim that the positive dependence of momentum on liquidity risk is explainable by the simple fact that *"momentum represents the most popular trades, as investors chase returns and flock to the assets whose prices appreciated most recently"*. On the other hand, the negative dependence of value might be reasonable, as value represents the opposite view (p. 931):

> When a liquidity shock occurs, investors engaged in liquidating sell-offs (due to cash needs and risk management) will put more price pressure on the most popular and crowded trades, such as high momentum securities, as everyone runs for the exit at the same time (Pedersen, 2009), while the less crowded contrarian/value trades will be less affected (pp. 932-933).

Asness, Moskowitz and Pedersen (2013) consider both funding and market liquidity shocks. Overall, they suggest to build the portfolio by equally weighting value and momentum, as by doing so, the portfolio can be immunized against liquidity risk factors (p. 931).

On the other hand, Koijen et al. (2012) investigate the question whether carry or the expected price appreciation is impacted by macroeconomic and/or liquidity risks (p. 3). They found that fixed income markets produce rather higher returns during times of carry downturns, which in turn are likely to happen during major global macroeconomic events, global business cycles and lower global liquidity. Unlike equities, commodities or currencies, which can suffer high losses during extreme global recessions and liquidity issues, government bonds are likely to generate large returns during this time (pp. 4-5).

2.2. Yield Curve

2.2.1. Principal Component Analysis

In the field of finance, a statistical method called the Principal Component Analysis (PCA) has been largely applied to short-, mid- and long-term interest rates in order to figure out the common factors responsible for changes and shifts in the yield curve (Wu, 2003, p. 24). This technique enables the user to interpret large and complex datasets in an easier and more manageable way, as it eliminates overlapping information from a group of market variables finally coming up with a reduced set of uncorrelated components that explain the largest percentage of a dataset's variance (Giannopoulos, Haworth, & Pelata, 2012, p. 4). In other words, a PCA makes a dataset simpler by removing less relevant data and focusing on the principal components, which have the highest explanatory weights. All other components are disregarded. All components, beginning with the one with the highest weight, are considered until they describe at least 95% of the variance together as a group of components. From running a PCA on a specific dataset, two measures result, which are of particular importance: the loadings and the residuals. While former can be referred as sensitivities to the principal components, which in turn are common to all variables subject to the analysis, latter are rather specific factors to each variable and therefore not common (Litterman & Scheinkman, 1991, pp. 56-57).

In fixed income, the results of a PCA can be used for purposes of trading and risk management. While for the former, the residuals of the PCA are useful, for the second, the loadings are of importance (Giannopoulos, Haworth, & Pelata, 2012, pp. 11-12). Further details on the use of residuals for trading purposes can be found in section 3.3.5. To date, several studies have been conducted on the use of PCA for the construction of stress scenarios. Frye (1997) and Loretan (1997) construct scenarios based on a factor-based approach to come up with the Value at Risk (VaR) for their fixed income portfolios. Under a factor-based approach, a scenario is the result of linearly adding the loadings of the components one wants to include. Depending on the scenario, the single loadings are either positive or negative. Frye (1997) constructs sixteen scenarios, as in addition to the three components – level, steepness and curvature – he includes the fourth component. Frye (1997) defines the VaR of his portfolio as the highest scenario loss. Latter is used in order to better explain the spreads between the interest rates on the yield curve. Loretan (1997) considers only the first three components for the scenario construction. In total, he creates four scenarios. Three of them arise from applying shocks solely to one component, while holding the other two components stable. The direction of the shocks is the same as specified by the respective component. The last scenario is the result of adding up the shocks of the first three scenarios. Fiori and Iannotti (2006) base their VaR calculation on the principal components, but undertaking Monte Carlo simulations. They apply a parametric and a non-parametric approach.

2.2.2. Common Factors

According to Littermann and Scheinkman (1991), the largest proportion of bond returns can be explained by three unobservable components called *level, steepness and curvature*, from the most to the least determining (p. 54). A shock in the level causes all interest rates on the yield curve, from the very short to the very long end to shift downwards or upwards parallel to its origin. A shock in the steepness induces unequal shifts depending on the maturity. It shifts short-term interest rates to a larger extent than long-term interest rates, decreasing the slope of the yield curve. Finally, a shock in the curvature causes mid-term interest rates to shift by a greater amount than both short- and long-term interest rates, resulting in a more *"hump-shaped"* curve (Wu, 2003, p. 24). Littermann and Scheinkman (1991) examine excess returns of both zero-coupon and coupon-paying bonds over the risk-free rate and conclude that while the three components explain former at least to 96% (pp. 57-58), the same three components explain second at least to 94% (p. 59). Within both frameworks, they include bonds of short- to long-term maturities into the PCA. The robustness of the first two components – level and slope - is confirmed by Phoa (2000) who states that shifts in these two components are the most dominant kinds of changes in the yield curve, with first being significantly more determining than the second. However, this conclusion is not made for the curvature, as its significance may be high-

ly dependent on the data analysed (p. 162). By means of a macroeconomic model and a *schematic breakdown of interest rate expectations* (pp. 179-180), Phoa (2000) presents some macroeconomic explanations for why the level and steepness of the yield curve may shift, but refrains from doing so for the curvature as this factor is perceived to be neither consistent nor permanent (p. 179). In the setting of the macroeconomic model, Phoa (2000) points out that a shift in the yield curve's level arises if both the *current short-term nominal interest rate* and the *long-term expected future interest rate* change at the same time, whereas the yield curve's steepness shifts with a change in either one of the two. In the other context, shifts in the yield curve arise upon the revision of the future interest rates' expectations from the market participants' side. More precisely, shifts occur when either future inflation or output growth are revised. For a level shift to occur, a change in both the *short-term and long-term expectations* needs to occur at the same time and *by the same amount*. On the other hand, for a steepness shift to happen only either the short-term or the long-term expectations need to change, while the other remains stable (p. 180). On a whole, the level shift's dominance over the steepness shift is explainable by the fact that in financial markets, short-term events not only drive short-term expectations, but are also the main driver of long-term expectations (Phoa, 2000, pp. 180-181). Such short-term events can be of macroeconomic nature. To exemplify, when central banks raise (lower) interbank rates in order to counteract high (low) inflation, expectations on *future inflation, economic activity and the path* of the interbank rate determine the long-term interest rates (Wu, 2003, p. 24). To date, many studies have been conducted on the macroeconomic drivers of the components level, steepness and curvature. Among others, Ang and Piazessi (2001) as well as Evans and Marshall (2001) analyze what effects inflation and economic activity variables have on the yield curve, by undertaking different approaches. In both studies, the authors come to the conclusion that short- and medium-term bond yields are not only driven by the three unobservable components, but also by inflation and real economic activity. However, their results differ with regard to the influence of macroeconomic variables on the long end of the yield curve. While Evans and Marshall (2001) find evidence in favor of a significant contribution of macroeconomic variables on the determination of longer-term bond yields, Ang and Piazzesi (2001) do not. In other words, only the results of Evans and Marshall (2001) support the determining power of macroeconomic factors on the level of the yield curve. On the other hand, Wu (2001) analyzes whether the US yield curve is influenced by unexpected actions on behalf of the Fed. He finds a strong but short-lived effect of surprising monetary policy actions on the slope, but not on the level of the yield curve. His results show that such actions account for 80 to 90% of changes in the slope, but that such effects do not last longer than *one to two months*. Wu (2003) again emphasizes the influence of monetary policy actions on the yield curve's slope. He claims that restrictive monetary policy actions shift the slope of the yield curve downwards. Even though contractionary monetary policy may lead to *high nominal short-term interest rates* at the very begin-

ning, this effect may be short-timed and fall rapidly again. Responsible for this is the anti-inflationary effect a tightening has. He further scrutinizes the evidence on the low effect macroeconomic variables may have on the long-end of the yield curve and encourages to conduct further research in this area, since after all, *long-term nominal interest rates* are the result of *expected long-run inflation and long-term real interest rates* (p. 26). Wu (2014) studies how long-term interest rates are impacted by unconventional monetary policy, more precisely QE. For this purpose, he analyzes the four QE-phases from the end of 2008 to mid-2013 on behalf of the Federal Open Market Committee (FOMC) (p. 8). With help of regression analyses, he shows that QEs effectively lowered the long-term yield of the US treasuries (p. 30).

2.2.3. Dependence on Macroeconomic Announcements

Over the years, extensive research has been conducted on the relationship between macroeconomic announcements and interest rates. For instance, Ederington and Lee (1993) study the impact of nineteen monthly macroeconomic announcements on treasury bond, Eurodollar and Deutschemark futures during the period between November 1988 and 1991 (p. 1164). They find the employment report, Producer Price Index (PPI), Consumer Price Index (CPI) and durable goods orders, ordered according to effect size, to be the most determining announcements (pp. 1174-1178). Furthermore, they analyze the futures' price volatility and find it to be the highest on Fridays, when the employment report and the PPI are released (p. 1169). During the day, the futures prices are found to experience the biggest changes during the first minute after the announcement. In addition, the price volatility shoots up for fifteen minutes and decreases afterwards to a lower, but still high level, remaining there for several hours (p. 1189). Fleming & Remolona (1997) examine the impact of macroeconomic announcements on the US five-year t-note during a one-year period of high contractionary monetary policy actions on behalf of the Fed, ranging between August 1993 and August 1994 (p. 35). Equal to Ederington and Lee (1993), they find the sharpest price jumps to occur at the same date macroeconomic announcements are made. Among twenty-five kinds of announcements, nine result to be significant. According to their regression results, employment announcements have the highest effect, being twice as large as that of the second variable, which is the PPI. Latter is followed by the Federal funds target rate, retail sales, CPI, NAPM survey, five-year note auction results, industrial production, capacity utilization and consumer confidence, in a descending order of impact. Noteworthy is that GDP releases are not found to have neither consistent nor significant effects on the price of the US five-year t-note (pp. 41-42). Balduzzi, Elton and Green (1999) analyze the impact of macroeconomic news on short- to long-term yields, based on the three-month t-bill, two- and ten-year t-notes, as well as thirty-year t-bond (p. 3). These instruments are regarded during the period between beginning of July 1991 and end of September 1995. Out of twenty-six economic announcements, they find seventeen to significantly influence at least

one of the yields and eight to significantly influence the yields of all four maturities (p. 4). These are consumer confidence, durable goods orders, housing starts, initial unemployment claims, the NAPM index, new home sales, nonfarm payrolls and the PPI. Furthermore, the CPI significantly influences the two-, ten- and thirty-year yields, retail sales the three-month, two- and ten-year yields and lastly capacity utilization the two- and ten-year yields (p. 11). They also find that most of the significant factors are already priced within one minute after the news are disclosed, which confirms the finding of Eredington and Lee (1993) (p. 4). Goldberg and Leonard (2003) investigate how the Euro-area, German and the US markets are subject to each other's announcements. For this purpose, they analyze two- and ten-year yields of German and the US treasury notes during the period between January 2000 and end of June 2002. They find that the US announcements impact both the US treasury yields and the German bond yields significantly (pp. 1-2), but find evidence for the opposite not being the case (p. 6). Moreover, they find German bond yields to be influenced to a higher extent by the US than by Euro-area or German announcements. While short-end bond yields are at least statistically significant influenced by Euro-area GDP and inflation advances, they are not by German economic news. For instance, neither German employment nor German GDP advance news are found to significantly influence German bond yields (pp. 4-5). The US announcements move both the short- and the long-end of the yield curve, but especially the former. Changes are mainly attributable to the US labour market announcements on the unemployment rate and payrolls, consumer sentiment reports and real GDP advances. Overall, both ends of the yield curve are likely to increase when announcements exceed expectations and vice versa. Goldberg and Leonard (2003) find evidence that supports the findings of Ederington and Lee (1993) that prices change mainly within the first fifteen minutes following the news (pp. 1-3).

Bjursell, Wang and Webb (2010) examine the relationship between macroeconomic news releases, bigger price changes and trading volumes. For this purpose, they analyze data ranging between 2001 and 2004 for the Eurodollar, the US thirty-year t-bond and the US ten-year t-note futures. More precisely, using computerized trade reconstruction data, they investigate how trading volumes behave in the cases when prices react abruptly upon macroeconomic announcements, when price jumps occur on days where no news are released, when prices do not undergo significant variations even though macroeconomic news are published, and when neither price jumps occur nor macroeconomic news are released (p. 6). They focus on announcements on the CPI, durable goods orders, personal income, personal spending, the PPI and unemployment (p. 16). A few findings are highly remarkable. First, most abrupt price changes on announcement days can be traced back to news on unemployment, less to announcements on durable goods orders, and even less to PPI and the CPI. Second, even though no clear patterns can be observed from price co-movements across futures markets with regard to the type of news, it is remarkable that a considerable number of price co-movements on the US thirty-year

t-bond and the Eurodollar futures occur on days when unemployment reports are published (p. 27). Different to Ederington and Lee (1993), Balduzzi et al. (1999), Goldberg and Leonard (2003) or Bjursell, Wang and Webb (2010), who all examine several types of economic activity and inflation announcements in their respective studies, Gürkaynak, Sack and Swanson (2004) as well as Rogers, Scotti and Wright (2014) focus on the effect of monetary policy announcements on bond yields. While former examine conventional monetary policy announcements from 1990 to 2004 (Gürkaynak, Sack, & Swanson, 2004, p. 5), latter analyze unconventional monetary policy announcements from 2007 to 2013 (Rogers, Scotti, & Wright, 2014, p. 15). In more detail, Gürkaynak, Sack and Swanson (2004) aim to figure out whether it is the monetary policy action itself or rather the way in which the announcements/statements are phrased that affects bond yields the most. They find that many announcements on behalf of the FOMC had caused little to no surprise, as they were somewhat expected by the financial market beforehand. It had rather been the economy and policy outlooks that mainly influenced short-term interest rates after the announcement (pp. 11-12). They showed this based on several Eurodollar and Federal funds futures contracts with maturities between three months and one year (p. 12). On the other hand, Rogers, Scotti and Wright (2014) analyse the effect of the unconventional monetary policy announcements on behalf of the Fed, the European central bank as well as the central banks of England and Japan on their respective bond yields (pp. 11-12). Similarly to Goldberg and Leonard (2003) who find a significant effect of the US announcements on German bond yields but not the other way around, Rogers, Scotti and Wright (2014) find the same patterns with regard to monetary policy announcements (p. 16). Furthermore, they confirm that other than conventional monetary policy surprises, which influence the short-end of the yield curve the most, unconventional monetary policy surprises are found to have the highest effect on the long-end of the yield curve (p. 19).

2.3. Market Implied Information

In the world of fixed income, many different sources exist that provide information on market expectations. For instance, market expectations about forward rates from swap curves or zero-coupon spot rate curves, volatility of forward rates from caps and/or floors, volatility of swap rates implied in swaptions, default probabilities from CDS spreads, future inflation from TIPS or inflation swaps or on the probability of future monetary policy decisions implied in the Fed funds future. This study examines solely the latter two as the potential trading triggers.

2.3.1. Probability of Fed Policy Shift

The financial world is highly dependent on the changes the FOMC undertakes to the federal funds rate. The effect of FOMC's actions is not limited only to the US financial market, but is rather of global reach (Chicago Board of Trade, 2003, p. 11). Practitioners often use Federal funds futures to extract information on potential actions on behalf of the FOMC. The underlying

of a federal fund futures contract is the average federal funds rate of that contract's maturity (Nosal, 2001) and therefore needs to be distinguished from t-bill futures contracts, whose underlying is the rate on a specific day (Robertson & Thornton, 1997, p. 45). Since October 1988, Federal funds futures are traded on the Chicago Board of Trade (CBOT). These futures can take on several maturities, from one to twenty-four months in the future (Robertson & Thornton, 1997, p. 45). The technical ideas behind it can be found in the section 3.3.1, when it comes to the application of such.

To date, several studies have been conducted on the predictability of federal funds futures on monetary policy actions. For instance, Carlson, McIntire and Thomson (1995) analyze the predictive power of Federal funds futures rates on future rate changes one to five months ahead during the period from 1988 to December 1994 and conclude that the higher the predictive power is, the shorter the forecast horizon will be (pp. 24-28). Robertson and Thornton (1997) examine the future's rate forecasting ability only one month ahead and during a somewhat larger period beginning on October 1988, but extending to August 1997. In a first step, they base their forecast on the one-month Federal funds future rate only. They find the forecasting ability of the one-month rate to be significantly better when no rate change is expected as when one is expected. In a second step, they incorporate the two-month Federal funds future rate and conclude that using both rates improves the forecasting accuracy, but at the same time reduces its reliability (p. 52). Söderström (1999) examines the expectations on target rate changes during the first ten years since inception of the Federal funds future. Unlike Carlson, McIntire and Thomson (1995) or Robertson and Thornton (1997), he does not analyze the predictive power of the federal fund future's rate on target rate changes one to five months in the future, but rather on the potential changes in the average funds rate during the current month of the futures contract. Therefore, he analyses these expectations not in the short-, but rather in the very short-term. According to his results, expectations on potential rate changes during the current contract's month are fairly well predicted during the period between January 1994 and February 1998. Nevertheless, he emphasizes the need of adjusting expectations for volatility across months. This monthly variations are attributable to varying risk premia caused by volatility changes in the cash market underlying the future (pp. 27-28).

2.3.2. Implied Inflation Rates

In addition to monetary policy actions, inflation is also perceived as a main driver of interest rate changes. Inflation expectations can be measured through either surveys or financial market information. Surveys are typically addressed to different groups such as professional forecasters and/or consumers. Surveys, as a whole, are perceived as the most direct inflation measures, as their purpose is precisely to find answers to specific questions related to the development of inflation. However, the use of surveys as inflation forecast has also disadvantages, which de-

pending on the context can outweigh its main benefits. Among others, the frequency may be an issue, as surveys are published either monthly or quarterly. Other issues may be unrepresentativeness due to an insufficiently high number of responses or information incompleteness (Golden & Monks, 2009, p. 70).

In the field of finance, practitioners prefer rather to extract inflation expectations from liquid financial instruments. Hereunder, the most commonly used instruments are indexed government bonds and inflation-indexed swaps (Golden & Monks, 2009, p. 70). One main advantage of considering information implied in liquid inflation-indexed instruments over survey content is that former render the average view of a high number of knowledgeable market participants and therefore may be more representative. In addition, other than surveys, data on such financial instruments is available at real-time (Golden & Monks, 2009, p. 76).

In this study, both financial instruments are considered as sources of inflation expectations as they may generate different estimates. More details on why these may differ can be gathered from the respective subsections.

2.3.2.1. TIPS

Treasury inflation protected securities (TIPS) were first introduced in 1997 in the United States (Kwan, 2005, p. 1). Even though also called inflation-indexed government bonds by many practitioners, TIPS might be the better term, as the former automatically excludes inflation-indexed government notes, which are also available. In contrast to the common government securities, the principal of TIPS is *linked to a price index*. Therefore, TIPS differ from conventional government notes and bonds in that they protect investors against changes in inflation. The yield difference between two treasury securities, each of one type, but equal maturity, is called break-even inflation rate. Latter is nothing else than the inflation rate, at which both types of treasury securities would return the same yield to maturity (Golden & Monks, 2009, p. 76). Regarded from a different perspective, the break-even inflation rate replicates the compensation holders of conventional government bonds receive for expected inflation as well as for not being protected against unexpected changes in inflation. Therefore, as the break-even inflation rate does not exclusively provide expectations on the development of the inflation rate, but also contains a risk-premium for unexpected inflation changes, the break-even rate does not mirror inflation expectations only. Another issue to account for when considering the break-even rate is the liquidity premium contained in the yield of TIPS. As TIPS are typically less traded than conventional treasury securities, the difference in yields between inflation-linked and conventional treasury securities also consists of a liquidity premium (Kwan, 2005, p. 2). However, even though both premia are likely to vary considerably over time, they mostly balance effects so that break-even inflation rates resemble inflation expectations. While the inflation risk-premium causes the break-even inflation rate to overstate expectations, the liquidity premium does exact-

ly the opposite (Christensen & Gillan, 2011, p. 1). This discrepancy between inflation expectations and the break-even inflation rate is further reduced the shorter the period and the more liquid the TIPS are (Kwan, 2005, p. 2). In addition to being *available at a high frequency*, break-even inflation rates are also available for different maturities such as 5, 10 and 20 years, being useful as a forecasting tool for the shorter- and longer-term development of inflation rates (Christensen & Gillan, 2011, p. 1). In practice, medium-term inflation forecasts are often based on the break-even inflation rate between five-year yields of conventional notes and TIPS, while in the long-term inflation forecasts are typically based on forward yields of conventional treasury securities and TIPS. For instance, in case an investor would be willing to estimate the five-year inflation rate beginning in five-year's time, he would need to subtract the yield difference between the ten-year and five-year TIPS from the yield difference between the ten-year and five-year conventional treasury notes (Kwan, 2005, p. 3).

So far, lot of research has been conducted on the use of break-even rates as source of inflation expectations. Most of these studies focused on the effect liquidity and inflation risks have on inflation expectations. For instance, Christensen (2008) studies the behaviour of long-run inflation expectations implied in the break-even rate for the period between 2007 and 2008 (p. 1). For this purpose, he considers weekly conventional bond yields of eight different maturities, from the three-month t-bill to the ten-year t-note, starting on January 6, 1995. On the other hand, he analyses weekly TIPS yields not before January 2, 2003 and considers only six notes, being the five-, six-, seven-, eight-, nine- and ten-year. He examines TIPS yields on a shorter period due to liquidity issues before 2003. Furthermore, the difference in maturities does not result in a problem for the estimation of the break-even rate, as he adjusts estimations with a Kalman filter (p. 2). With the use of a *dynamic model of the term structure of interest rates* and a *simple arbitrage argument*, he manages to analyze the premium for expected inflation and inflation risk-premium separately and therefore counteract the problem that the break-even as a whole is not a reliable replication of inflation expectations (p. 1). On a whole, he finds that variations in the 10-year break-even rate are mainly caused by changes in the compensation for the inflation risk, while the compensation for expected inflation remains rather stable. Furthermore, he finds the risk-premium for unexpected inflation changes to be small, at most 25 basis points and in rare cases even slightly negative (p. 3). In the sequel, Christensen, Lopez and Rudebusch (2010) decompose the break-even rate with help of an *affine arbitrage-free model of the term structure*. They consider the same data as Christensen (2008) (p. 8) and confirm his finding that even though the inflation risk-premium behaves rather volatile, it is low in size (Christensen, Lopez, & Rudebusch, 2010). Apart from the several studies that accounted for the inflation risk-premium implied in the break-even rate, D'Amico, Kim and Wei (2006) as well as Christensen and Gillan (2011) focus on the second issue, the liquidity premium. Similarly to Christensen (2008) and Christensen, Lopez and Rudebusch (2010), D'Amico, Kim and Wei (2006) study the

liquidity premium based on an affine *no-arbitrage term structure model*. They analyse break-even rates between 1990 and 2013, based on seven and three maturities of conventional treasury securities and TIPS respectively. Alike Christensen (2008) and Christensen, Lopez and Rudebusch (2010), these are maturities between the three-month t-bill and the ten-year t-note for the conventional treasury securities and between the five-year and ten-year t-note for TIPS. Also here, the lower number of TIPS maturities is to be traced back to the small available set of maturities before 2003. However, different to Christensen (2008) or Christensen, Lopez and Rudebusch (2010), they examine TIPS yields from 1999 on (pp. 16 & 17). D'Amico, Kim and Wei (2006) emphasize the magnitude of the liquidity effect on the TIPS yield. They show that about 85% of the difference in yields between TIPS and conventional treasury securities are attributable to liquidity conditions (p. 36). On the other hand, Christensen and Gillan (2011) examine the liquidity effect on TIPS based on the difference between the inflation-indexed swap rates and break-even inflation rates of equal maturity. By doing so, they are able to identify changes in trading activity/liquidity (p. 2). Overall, they find that the liquidity effect on the break-even rate is much lower as claimed by D'Amico, Kim and Wei (2006) and therefore if not accounted for a lower liquidity premium, inflation expectations may be overstated (pp. 4-5).

2.3.2.2. Inflation Swaps

Inflation swaps, also first introduced in the 1990s, are bilateral contractual agreements traded over-the counter (OTC) (Hurd & Relleen, 2006, p. 25). These instruments differ from common swaps just in that the variable payment is linked to a price index (Golden & Monks, 2009, p. 78). Inflation swaps are available in different types. However, the most popular type is the *zero-coupon inflation swap* (Hurd & Relleen, 2006, p. 26). Within such, just one single payment occurs at maturity. This one takes on the size of the notional times the difference between the inflation rate at maturity and the fixed rate (Finlay & Olivan, 2012, p. 51). Over the years, professionals have increasingly used zero-coupon inflation swaps to estimate the average inflation rate during a given time span (Golden & Monks, 2009, p. 78). These are worth considering as an alternative to break-even rates as they are easy to use and may provide somewhat different estimates. Similarly to TIPS, inflation swaps' expectations may also be overstated by the term/inflation risk-premium. However, the shorter the time horizon, the less affect this issue should have on the inflation expectations. In addition, inflation swaps are prone to a greater counterparty risk. Latter may be of far less importance when considering break-even rates, as TIPS and conventional treasury securities are issued by sovereigns. Even though on a whole, both break-even rates and inflation swaps may provide similar expectations about future inflation, both measures can differ from each other to greater extents. For instance, prices of inflation swaps are more subject to rapid changes in demand and supply than TIPS, as their supply is more limited. Furthermore, expectations may also deviate due to the different time horizons for

which inflation can be estimated. While inflation swaps are quoted for a fixed time horizon and therefore inflation expectations are only possible for that specific period, a break-even rate allows for the estimation of varying periods, as the yield difference changes with time (Golden & Monks, 2009, p. 80). Nevertheless, the inflation swap market may also be attractive as it offers more maturities than TIPS and conventional treasury securities do, ranging between one and thirty years (Finlay & Olivan, 2012, pp. 45-46).

In contrast to inflation-linked treasury securities, little research has been done on inflation swaps. Moreover, it is remarkable that researchers have dealt with this source of inflation forecast mainly as a supplement to break-even inflation and in the rarest cases alone. Hurd and Relleen (2006) compare inflation expectations from both TIPS and inflation swaps over different time-horizons and across markets. More precisely, they set short-, mid- and long-term forward curves for the euro area, the UK, and the US. On a whole, they show that inflation swaps can perfectly be used as a provider of future inflation expectations. Gimeno and Ortega (2015) aim to find out the commonalities and country-specifications among European countries' inflation rates over multiple years. For this purpose, they use a *multi-country dynamic model* that includes inflation expectations from fifteen maturities inflation swaps (1 to 30 years) for France, Germany, Italy and Spain (p. 11). For matters of reliability, they compare these expectations with those of professional forecasters' surveys. They find one component to contribute across all four countries throughout, especially during the long-term, what in turn somewhat confirms the assumption of a similar inflation expectation across countries underlying the same monetary policy (p. 13). Furthermore, they find a country-specific component that contributes rather during shorter time horizons as well as a volatile liquidity risk. Both the country-specific component and the liquidity risk are both of small size and vary in some countries more than in others (pp. 13 & 14). Alike researchers dealing with break-even inflation expectations such as D'Amico, Kim and Wei (2006) or Christensen, Lopez and Rudebusch (2010), Gospodinov and Wei (2015) use an *affine no-arbitrage model* of the term structure to extract inflation expectations implied in the US market. Besides break-even rates from TIPS, they also include inflation options and inflation swaps to gain additional information on inflation expectations (p. 2). More precisely, using the inflation swap data from 2004 to 2015 (pp. 5-6), they judge the liquidity premium incorporated in break-even rates with help of inflation swaps. Similarly to Christensen and Gillan (2011), they judge the liquidity based on the difference between inflation swap rates and break-even inflation rates of equal maturity (p. 8). Overall, they conclude that the liquidity premium makes out a big part of the break-even rate's variability (p. 9).

3. Bond Portfolio Management

This section aims to illustrate how the price of bond futures may behave under different interest rate environments, such as shifts and/or twists in the yield curve. Moreover, it aims to show

how the portfolios underlying the investment styles carry, momentum and value were constructed and managed within a long/short portfolio context. More precisely, it illustrates how the weights were determined and how the trading signals were constructed before presenting the portfolios' performances under a decreasing and increasing interest rate environment. In the sequel, it is explained which information was tested on its effectiveness as potential trading triggers besides the trading signals underlying the investment styles and if applicable, the performances from the futures traded. Under further trading tools are meant inflation expectations implied in financial instruments like TIPS and inflations swaps, announcements on current inflation and economic growth, cash rate decisions and LSAPs on behalf of the central banks, as well as interest rate based PCA results. In order to better account for their usefulness, these potential trading triggers were not regarded within the investment styles-based portfolios, but rather separately.

3.1. Behavior of Bond Futures under Different Interest Rate Environments

In recent years, long-position holders of treasury futures have profited from increasing futures prices due to both positive roll yields and decreasing interest rates. They are likely to continue doing so, should the yield curve remain positively sloped and interest rates keep declining. The effect these two profit sources have on a bond futures price under these conditions, is illustrated by figure 2, on page 90. Latter shows the development of the US ten-year t-note future, as well as the development of the returns arising from the decreasing US ten-year t-note rate and the positive carry over the period between August 1st and September 29, 2006. The development of a futures price depends mainly on how high the carry effect and the rise in interest rates are. As a positively sloped yield curve implies a positive carry and increasing interest rates depreciate the price of the future the more the higher the changes are, futures prices may increase only if they are positively influenced by the carry to a higher extent than negatively affected by the increase in interest rates. If the effects are of similar size, the positive roll yield and the price depreciation caused by rising interest rates, may offset each other, leading the futures price to move rather sideways than upwards. How a sideways move may come along is exemplified by figure 3, which shows the same as figure 2, but over a shorter period between June 1st and July 1st, 2005. However, it shall be noted that during latter, the fluctuation of the US ten-year t-Note future was not a result of offsetting, but rather similar effects. In case of experiencing sharply increasing interest rates, while the yield curve remaining positively sloped, the negative effect of the rate change on the futures price may be higher than the positive effect of the carry. Consequently, the price depreciation would be higher than the positive roll yield, leading to a decrease in the futures price. This relation is illustrated by figure 4, on page 91, again based on the US ten-year t-note future, but now during the period ranging between November 5 and December 15, 2010. In case of the yield curve flattening or even inverting under both a decreasing and increasing interest rate environment, the futures price may be negatively affected by the lower

or even negative effect the carry has on it. While under a decreasing interest rate environment, the futures price may be hindered from appreciating due to a lower carry in case of the yield curve being flat, under an increasing interest rate environment, the futures price is likely to depreciate due to both the interest rate development and the inability of gaining a higher carry. On the other hand, an inverted yield curve may lead a futures price to move sideways under a decreasing interest rate environment due to its negative carry, whereas downwards under an increasing interest rate environment due to the double negative impact the carry effect and the interest rate development have on it. Therefore, inverted yield curves compensate if at all, rather those that hold a short position than those that hold a long-position in the future (Niederhoffer & Weddepohl, 2014, pp. 5-6). Over the last decades, the US yield curve has rarely been inverted. Figure 5, on page 91, exemplifies this rather unusual yield curve structure again based on the US ten-year t-note future over the short period from February 2, to February 10, 2000 (Pan, 2006, p. 2).

Overall, it can be said that under a positively sloped yield curve it is more challenging to obtain attractive returns during increasing interest rate periods than during decreasing interest rate periods. While under a decreasing interest rate environment one would profit the most when being long, under an increasing interest rate environment one would profit the most when being short. However, it shall be noted that undertaking the reverse trade when interest rates increase does not lead to equal high returns. In other words, selling short futures during periods of increasing interest rates and a positively sloped yield curve may lead to returns lower than during periods of decreasing interest rates and a positively sloped yield curve (Niederhoffer & Weddepohl, 2014, p. 7).

3.2. Investment Style Portfolios

As outlined in the section “data and methodology”, the data necessary for the construction of investment style portfolios is extracted from Bloomberg and on a daily basis. The data relevant for this analysis are the constant maturity zero coupon yields, as well as the treasury bond futures prices.

3.2.1. Portfolio Construction

The bond futures traded in this study are restricted to follow short-term trends only. Therefore, directional and cross-sectional trades are expected to be held not for weeks, months or even years, as it would be the case when pursuing medium- to long-term trends, but just for days. An important advantage of trend investing using futures over bonds is that latter offer high liquidity, low transaction costs and require relatively small amounts of principal due to the high leverage they have (Fattouche, Ghia, & Staal, 2014, p. 5). As this study examines momentum investing only on treasury security futures, it is not necessary to neglect most recent times as Asness,

Moskowitz and Pedersen (2013) did, as such are not likely to be subject to liquidity concerns. The indicators for carry, momentum and value were computed according to Baz et al. (2015). Based on these indicators, the trading signals were constructed by generating a signal to go long the future whenever the values were positive and to go short the future whenever the values were negative. However, this approach was applicable only within a time-serial context. Although within a cross-sectional framework the indicators were constructed the same way, the signals were not generated according to the sign of the indicators, but rather according to their weights. How latter were determined is explained in section 3.2.1.1.

As mentioned previously, the portfolios considered in this study follow the long/short investment strategies of carry trades, momentum and value investing. These investment strategies are conducted always in both a time-serial and cross-sectional framework. The portfolios are composed of one single investment strategy, managed either in a time-serial or cross-sectional framework. As this study regards every investment strategy in both frameworks, and cross-sectional carry trades are conducted in two different manners, in total seven single portfolios were constructed. These are the time-serial (TSC) and the two cross-sectional carry trade portfolios (1. & 2. CSC), the time-serial (TSM) and the cross-sectional momentum-investing portfolios (CSM), as well as the time-serial (TSV) and cross-sectional value-investing portfolios (CSV). Apart from being regarded when based on one investment style only, portfolios are also regarded when based on several investment styles. However, investment style combinations are analysed only within a time-serial framework. This results in three combinations of two, being the time-serial carry and value (TSC & TSV) portfolio, the time-serial carry and momentum (TSC & TSM) portfolio, as well as the time-serial momentum and value (TSM & TSV) portfolio. Finally, it is also accounted for the portfolio traded upon all three investment styles together.

Every single portfolio is diversified among tenors and currencies, as it is composed of short- to long-term treasury futures of the United States, the European Union, Australia and Japan. These take on the maturities of three months, two, five, ten and thirty years for the United States and the European Union, and three months and ten years for Australia and Japan. Diversification is further enhanced through the long and short trading of trend and carry signals. The application of trend and carry signals to a long/short investment portfolio allows for a higher diversification than an equally diversified long-only investment portfolio, as it lowers or even breaks correlations among sovereign bond futures. The portfolios based on the three investment styles – carry, momentum and value – were regarded under both a decreasing and increasing interest rate environment. As since 1982 the interest rates have been decreasing, enough data of decreasing interest rate periods is available. However, this is not the case with increasing interest rates. Even though the last period of rising interest rates has lasted for twenty-seven years, from April 1954 to 1981, no sovereign bond future has been traded at that time (Niederhoffer & Weddepohl, 2014, p. 2). Therefore, as no data is available for the futures during large increasing interest rate

periods, it seemed reasonable to simply reverse the data used when examining the portfolios under a decreasing interest rate environment, as Niederhoffer and Weddepohl (2014) did before. The portfolios were constructed based on an in-sample extending from January 1st, 2001 to December 31, 2007, and tested in an out-of-sample ranging between May 3, 2010 and March 3, 2017. Even though in recent years treasury rates have not increased over larger periods, Niederhoffer and Weddepohl (2014) found fourteen short periods falling between 1998 to 2013 (see table 5, on page 88), all of unequal widths, where the US ten-year t-note rate had increased (p. 10). However, this study does not consider all of them. As the portfolios constructed in this work include not only the US ten-year t-note future, but also many other sovereign treasury futures of other regions and maturities, it seemed reasonable to test the portfolios solely across those time periods proposed by Niederhoffer and Wedderpohl (2014), where all interest rates of the US and the European union developed positively. In the tables 6 and 7, on page 89, possible periods to be considered for this analysis are marked accordingly. Therefrom, only five periods were further considered. These are the periods extending from June 6 to September 2, 2003, from March 17 to June 14, 2004, from June 28 to November 14, 2005, from June 1st, 2005 to June 1st 2006 and from November 5, 2010 to March 3, 2011. One delimitation of this analysis is the lack of data on the Australian three-month t-bill rate. As latter was not available until May 19, 2009, as a consequence, signals could not be computed up to this time. Therefore, whenever a period to be examined fell before mid of 2009, the portfolios did not consider the Australian three-month future. The periods affected by this lack of data are the in-sample, all short time-periods falling in the in-sample, as well as the inverted out-of-sample. Every portfolio is managed according to the trading signals corresponding to the investment style it is based on. How the trading signals were constructed for the carry trades, value- and momentum-investing portfolios can be found in section 3.2.1.1.

In practice, different methods are applied when conducting carry trades. For instance, in a time-serial context, meaning when trading all instruments of a portfolio equally, independently of how their relative importance is when compared with other assets, long and short positions can simply be taken whenever the carry is positive and negative respectively. On the other hand, in a cross-sectional context, where the components of a portfolio are considered depending on their relative importance, the two main methods are widely used. One is to rank the portfolio assets according to the size of their carry and to go long (short) the 20 to 30% of those with the most positive (negative) carry, weighting each future equally. The bond futures in between are not considered at all and therefore are applied a weight of zero. An alternative to this method would be to trade not only the extremes, but all futures by weighting them according to their carry ranking (Koijen et al., 2015, p. 19):

(14) $$w_t^i = \frac{\left(rank(C_t^i) - \frac{N_t+1}{2}\right)}{z_{N_t}}$$

Where w_t^i and C_t^i equal the weight and the carry of the portfolio component i at time t respectively. Including z_{N_t} allows for summing up long and short positions to +1 and -1 respectively. Therefore when the numerator$\left(rank\left(C_t^i\right) - \frac{N_t+1}{2}\right)$ is positive (long position), latter is divided by z_{N_t}, which in turn equals the sum of all portfolio components' numerators which are positive at time t. Exactly the opposite is the case when the numerator is negative (short position). Then, z_{N_t} rather embodies the sum of all negative numerators (Koijen et al., 2015, p. 19).

In this study, carry trades are conducted in a time-serial and a cross-sectional context. Furthermore, portfolios managed in a cross-sectional framework follow both methods. When applying the second method, the bandwidth of 20 to 30% assets with the highest (lowest) carry is managed by going long (short) on all treasury bill/note/bond futures that fall above (below) the third (first) quartile. Furthermore, long (short) positions falling above (below) the third (first) quartile are only taken if their carry is positive (negative). As it might be the case that at some points in time a future may exhibit a carry being lower than that of the remaining 75% of futures held in the portfolio, it may be that its carry is not negative. Therefore, by applying this restriction, one can prevent a positive carry future from being considered as a short position. Furthermore, the daily demarcation according to quartiles seems also to be legitimate as by just trading a fixed percentage of assets every day, it may be the case that one forgoes the trading of a further asset with a similar high or low carry and therefore could not profit from being exposed to this asset too. An important amendment that needs to be done to this weighting scheme is the consideration of the assets' durations. The application of equal weights to the long and short positions makes little sense as it endangers that the portfolio may unnecessarily be subject to a higher risk, while a lower one may be possible. For instance, assume a three-month, a five- and a ten-year future to be among the assets with the highest carries and the carry to be the highest for the three-month future, then the five-year future and lastly for the ten-year future. If one would apply the same weight to all three futures, one would be exposed to the three-month and to the ten-year futures to a lower and to a higher extent than would be optimal. As a consequence, one would profit less from the higher carry in the three-month future and being relatively higher exposed to the ten-year future which in comparison has the lowest carry. This issue is counteracted by simply weighting the long positions and short positions according to their carry. Following weighting scheme is applied to the long and short positions separately:

(15) $$Weight\ for\ long\ position\ i = \ w_t^i = \frac{C_i^t\ if\ C_i^t > 3rd\ quartile}{\sum_i^N C_i^t\ if C_i^t > 3rd\ quartile} * 1$$

(16) $$Weight\ for\ short\ position\ i = w_t^i = \frac{C_i^t\ if\ C_i^t < 1st\ quartile}{\sum_i^N C_i^t\ if\ C_i^t < 1st\ quartile} * -1$$

Here, C_t^i stands for the carry signal of the bond future i at time t.

On the other hand, the weightings applied in the first cross-sectional carry trades do not need to be adjusted for the duration, as the formula applied for the ranking already considers such.

Independently of whether a time-serial or a cross-sectional carry trade portfolio is conducted, the portfolio carry is calculated the same way. In the first step, the daily profit and loss (P&L) arising from carry is computed for every bond future included in the portfolio. For illustration, assume the daily carry P&L, here also called carry effect, to be computed for any of the ten-year sovereign bond futures (Koijen et al., 2015, p. 13):

$$(17) \qquad CE_t = \left\{\left[(y_{10Y,t} - rf_{3M,t}) * (\tfrac{1}{252})\right] * \left[-D_{10Y,t} * (y_{10Y,t} - y_{10Y,t-1})\right]\right\} * w_{10Y\,Ft,t-2}$$

Where CE_t stands for the daily P&L gained through carry on the underlying bond future, $10Y$ for the ten-year t-bond rate, D for its modified duration, rf_{3M} for the corresponding three-month t-bill rate and $w_{10Y\,Ft,t-1}$ for the weight applied to the ten-year future. Equation 17 is nothing else than a transformation of equation 12, proposed by Koijen et al. (2015). While the first part of the equation represents the slope, the second part is illustrative for the roll-down component. Note that also here a one-day lag is considered between the allocation $(t-2)$ and the trade. The weight of the bond future is positive (negative) when long (short). In a second step, the carry of the portfolio ($C_t{}^{portfolio}$) is computed by simply taking the difference between the sum of carry-weighted long-positions (highest positive carry securities) and the sum of carry-weighted short-positions (most negative carry securities) each day (Koijen et al., 2015, pp. 19-20):

$$(18) \qquad C_t{}^{portfolio} = \sum_{w_t^i>0} w_t^i CE_t^i - \sum_{w_t^i<0} |w_t^i| CE_t^i \; > 0$$

Koijen et al. (2012) claim that in spite of the method applied and the fact that short-positions are involved, the carry portfolio itself has always a positive carry (p. 20). However, Koijen et al. (2012) draw this conclusion based on the performance of carry portfolios under a decreasing interest rate environment only. Therefore, this study examines whether this is true under both a decreasing and increasing interest rate environment.

When the portfolio is based on either momentum or value, in a time-serial context long positions are held when the signal is positive and short positions when the signal is negative. On the other hand, in a cross-sectional context, only the futures exhibiting the highest positive (most negative) momentum/value signal are held long (short). As within carry trades, in a cross-sectional framework, futures are only considered when their momentum/value signal is positioned above the third quartile or below the first quartile of all bond futures' signals respectively.

3.2.1.1. Trading Signals

After having explained how the carry, momentum and value signals are traded, in the following it is illustrated how these signals were constructed. The carry signals are generated according to

Baz et al. (2015), who define carry as the sum of the carry and the roll down components. Taking any of the sovereign ten-year futures as an example, the two components were constructed as follows (p. 10):

(19) $$\boldsymbol{Carry_t} = \frac{y_{10Y,t} - y_{3M,t}}{Duration_{10Y,t}}$$

Where y stands for the treasury rate and $Duration$ for the treasury rate's modified duration, latter being denoted as:

$$Duration_t = \frac{1 - \left(1 + y_{10Y,t}\right)^{-10}}{y_{10Y,t}}$$

and

(20) $$\boldsymbol{roll\ down_t} = \frac{y_{30Y,t} - y_{1d,t}}{30}$$

(21) $$\boldsymbol{Carry\ Signal_t} = Carry_t + roll\ down_t$$

where y_{1d} represents the overnight treasury rate. The roll-down component was neglected for the Australian and the Japanese futures, as for both only the three-month and ten-year interest rates and futures were considered.

Similar to Baz et al. (2015), the value signals were generated by taking the difference between the maturity i-treasury rate and the quarterly nominal GDP growth rate lagged by one quarter. Even though the GDP growth rate could also have been replaced by the CPI inflation quarterly change, second option is neglected as according to Baz et al. (2015) both methods should provide nearly the same results (p. 12). Again, taking any of the ten-year bond futures as an example, the value signal was computed as follows:

(22) $$\boldsymbol{Value\ Signal_t} = y_{10Y,t} - GDP_{t-3months}$$

Where $GDP_{t-3months}$ is not the current GDP growth rate, but that published one quarter before.

Analogous to Baz et al. (2015) (pp. 10-11), a CTA momentum signal is used for momentum investing. Except for using the treasury interest rates instead of swap rates, which has also been the case when conducting the signals for carry and value, the approach and the values used here are the same as those used by Baz et al. (2015). First, three short and three long Exponentially Moving Averages (EMA) in the size of 8, 16, 32 and 24, 48, 96 respectively, were computed. These are based on the rate underlying the treasury security future considered. The EMAs were then adjusted with a decay factor $(\lambda)\frac{n-1}{n}$ before used to build the three crossovers (x_i) 8/24,

16/48 and 32/96. As it is visible in the following example, an EMA crossover is simply the result from subtracting the long from the short EMA:

(23) $$e.g.\ x_i = short\ EMA_{8-days} - long\ EMA_{24-days}$$

Second, each crossover's time series is normalized with its most recent three-month volatility (y_i), before the new time series is again normalized, but now with its volatility over the most recent 252 days (z_i).

(24) $$First\ normalization = y_i = \frac{x_i}{3-month'\ \sigma_{x_i}}$$

(25) $$Second\ normalization = z_i = \frac{y_i}{252-days'\ \sigma_{y_i}}$$

Third, for all three sets of EMA crossovers, intermediate signals (u_i) are calculated based on the restrictions of a response function (R_x):

(26) $$u_i = R(z_i),$$

where

(27) $$R(x) = \frac{xexp\left(\frac{-x^2}{4}\right)}{0{,}89}$$

Finally, the CTA momentum signal results from equally weighting the three intermediate signals and adding them:

(28) $$\boldsymbol{Momentum\ Signal_t} = \sum_{i=1}^{3} \frac{1}{3} * u_i$$

3.2.2. Performance

As mentioned before, investment style portfolios were analysed when applied alone and in combination. While each investment style was regarded within both a time-serial and cross-sectional context when applied in isolation, combinations of investment styles were only regarded when traded time-serially. All portfolios were compared with each, as well as with a buy-and-hold strategy under both a risk-adjusted and risk-non-adjusted gross-return criterion. Furthermore, all portfolios were first analysed under a decreasing interest rate environment based on the in-sample and the out-of-sample and second under an increasing interest rate environment like the inverted in- and out-of-sample, as well as the five short-term periods outlined in section 3.2.1. Over the short increasing interest rate periods, only the performance of the single portfolios was examined. As mentioned in the section 1.4, those portfolios that resulted to outperform the buy-and-hold portfolio, were further analysed after considering transaction costs. From pages 92 to 113, the annualized performance and volatility, the reality check p-value, the risk-non-adjusted as well as risk-adjusted performances of every bond future is listed corresponding to the investment style it was traded upon and during the period it was observed.

From pages 114 to 118, the futures risk-adjusted performances are ranked relative to those of the buy-and-hold strategy. This ranking serves to compare the performances of the futures not only among the different investment styles, but also with a long-only portfolio strategy. In the sequel, both the single and combined portfolios as a whole are ranked separately and compared with the buy-and-hold strategy (B&H) portfolio on a risk-adjusted and a risk non-adjusted basis. In what follows, from pages 119 to 125, those investment style portfolios that achieved to outperform the buy-and-hold strategy before transaction costs are analyzed when accounting for such. The procedure is the same as when examining single and combined portfolios under a gross return criterion. However now, it is shown how the portfolio performances are affected when transaction costs amount are 0,01%, 0,02% or 0,03%. Afterwards, the correlation matrices needed for the computation of the portfolio variances are shown for every period. The idea behind showing these matrices is to illustrate whether the correlations among the bond futures are broken through the allowance for going long and short, as well as through the trading of trend and carry signals. Finally, on pages 125 and 126, table 49 shows the estimated carry gains for the time-serial and cross-sectional carry trade portfolios and for all periods. As outlined before, the portfolio carries are the result of summing up the portfolio component carries. It shall be noted that across some periods, the portfolio carries do not include the three-month nor the ten-year Australian futures. The reason for this is again the lack of data, which here does not allow for the computation of the carry P&L through those periods. Nevertheless, remember that this delimitation does not result to be problematic, as this study does not focus on comparing the carries through periods, but rather between decreasing and increasing interest rate environments as a whole, as well as between long/short and long-only portfolios.

3.2.2.1. Decreasing Interest Rate Environment

Table 8, on pages 92 and 93, shows the performance and risk figures of the portfolio components over the in-sample. Furthermore, table 21 on page 114, ranks the investment style portfolios and the B&H portfolio on their risk-adjusted performance. As latter table shows, within the TSV, all US, both Japanese, as well as the European futures with maturities of three months, two and ten years perform better or at least as well as the equally weighted portfolio components of the buy-and-hold strategy. According to the table 8, the underperformance of the Euro-Bobl five-year and the Euro-Buxl thirty-year futures over the equivalents of the buy-and-hold strategy is that tiny that it is not recognizable when considering the Sharpe ratio with up to four decimal places. Remarkable is that despite a significant number of futures performing better when traded time-serially according to value signals as when pursuing a passive long-only strategy, only the performance of the Euro-Buxl thirty-year future results to be significant at a 90% level. Among the remaining six investment style portfolios, only the TSC leads a considerable number of futures to outperform their equivalents of the buy-and-hold strategy. Among all other

portfolios, only a few futures achieve to do so. For the TSC, it is the Eurodollar, the US two-year t-note, the US thirty-year t-bond, the Euribor three-month, the Euro-bund ten-year, the Euro-buxl thirty year future, as well as the Japanese ten-year t-note future that achieve a higher risk-adjusted performance than those of the buy-and-hold strategy. As well recognizable on table 21, on a whole, the futures traded according to TSV, TSC as well as B&H perform the best. This observation can be made also to some extent when regarding the performance of the portfolios as a whole. Table 22, on page 114, ranks the single investment style portfolios and compares them with the B&H portfolio. It is observable that also under a whole portfolio perspective, the investment styles TSV and TSC are of the best performers. When including the futures into a portfolio, independently of whether the performances are adjusted for risk, the CSV portfolio performs even better than the two. Among the single investment style portfolios, the portfolios traded according to TSM or CSM perform negatively and at the same time the worst. Moreover, only the TSC, TSV and CSV portfolios outperform the B&H equivalent when not accounting and when accounting for risk. While for the former two the outperformance is only slightly higher, for the latter it is rather considerable. The only difference between considering and neglecting risk is that under latter, the TSC and TSV portfolios change places. Otherwise, the same investment style portfolios that outperform/underperform the B&H when not accounting for risk, do it also when accounting for such. When looking at the estimated carry P&L on the portfolio components' performance, to be found on table 49, page 125, it is visible that in the US and the European treasury futures market, the highest carry is gained on the three-month, ten- and thirty-year futures independently of whether the portfolio is managed time-serially or cross-sectionally. Among the carry portfolios, that traded according to the 2. CSC exhibits the highest carry, while for all three portfolios the carry is positive. What is highly noticeable is that all three long/short strategies outperform the passive long-only strategy. This outperformance may arise due to the higher ability of long/short strategies to profit from changes in the slope of the yield curve. Latter can gain both positive and negative carries by being invested long and short when needed. On the other hand, the carry portfolios' whole period returns are positive. However, while the portfolio traded according to the 2. CSC gained the highest carry, its whole period performance is not the best. Among carry portfolios, that traded time-serially according to carry signals exhibits the highest performance within both a risk-adjusted and risk non-adjusted framework, followed by the 1. CSC portfolio. While the difference in returns is tiny between these two, the difference between their performance and that of the 2. CSC is relatively high.

Among the portfolios traded according to more than one investment style, the portfolio traded according to TSC and TSV clearly outperforms all other examined portfolio combinations. Furthermore, it is the only portfolio that achieves to outperform the B&H equivalent on both a risk-non-adjusted and risk-adjusted basis. Nonetheless, it shall be noted that the performance is not

induced only by the carry and value signals. As table 17, on page 110, shows, only the returns of the US two-, five- and ten-year futures, as well as the Euro-Schatz two-year, Euro-Bobl five-year and Euro-Buxl thirty-year futures are significant at the 90% level.

The correlation matrices on pages 126 and 127 further show that except for the TSV portfolio, the futures are as expected correlated to a lower extent when included in the long/short strategies as when included in the long-only strategy. However, some of them do not break the correlations between the US bond futures, especially between those with maturities larger two years. This is especially the case for the portfolios traded according to TSC, 1. CSC, TSM and obviously TSV. While the 2. CSC portfolio breaks correlations between the US bond futures with the exception of that between the two- and five-year t-note futures, as well as between the ten- and thirty-year t-note/bond futures, CSM leads these futures to be correlated to a lower extent, but still at a considerable level. Among all long/short investment strategies, it is only within the CSV portfolio that all correlations are broken to a level near zero. Furthermore, it can be said that if at all only the cross-sectional portfolios achieve to break correlations.

Over the out-of-sample, none of the investment styles, neither when time-serially nor cross-sectionally traded, leads futures to perform clearly better than when held passively long. This is perfectly visible on the single futures ranking, on table 23, page 114. Furthermore, as recognizable in table 9, pages 94 and 95, with a few exceptions, the returns are insignificant for all futures and investment styles. As within the in-sample, also the futures traded according to TSC or TSV are the futures which perform comparatively the best. However, for both only five out of fourteen futures achieve an equally high or higher performance than the long-only traded futures. On an aggregated basis, it is the TSC portfolio that achieves the highest performance, closely followed by the TSV portfolio. While the TSC portfolio exhibits an annualized performance of 2,3636%, the TSV equivalent achieves one of 2,2859%. Moreover, only these two, as well as the 1. CSC and CSV portfolios, perform positively over the whole out-of-sample. When neglecting risk, none of the investment style portfolios outperforms the B&H portfolio. However, when accounting for such, this is achieved by the portfolios traded according to TSC or TSV, with the second achieving the higher performance. Unlike the in-sample, the highest (lowest) portfolio carry is gained when futures are traded according to TSC (2. CSC). The TSC portfolio is at the same time the only carry portfolio to gain at least the same carry as the B&H portfolio. Furthermore, similar to what observed within the in-sample, among the US and the European futures, the highest carries are gained on those with maturities of ten and thirty years. On the other hand, the US and the EU three-month futures do not offer a comparatively higher carry anymore. The relation between the carry portfolios with regard to the whole period portfolio carry is perfectly reflected in the overall performance of the single carry portfolios. Among them, the TSC portfolio outperforms, followed by the 1. CSC and the 2. CSC portfolios, on the second and third place respectively. This is the case when accounting for risk as well as when

disregarding such. It may be concluded that over the out-of-sample, the higher performances gained by some carry portfolios may arise to big part due to the relatively higher carries they gain. Different to what observed over the in-sample, the 2. CSC portfolio does not achieve to perform positively.

Over the out-of-sample, it is also the combination of TSC and TSV that induces the highest risk-adjusted performance when compared to other portfolios traded upon several investment styles. Different to what observed over the in-sample however, the TSC/TSV combination outperforms the B&H portfolio only when accounting for risk.

Correlations between portfolio constituents are similar to those observed within the in-sample. However, in contrast to what observed in latter, now TSV causes the futures to be correlated to a lower extent than B&H does, whereas the TSC portfolio exhibits only partially lower correlations. On the other hand, similar to what we observed within the in-sample, correlations between the US bond futures with maturities larger than two years are comparatively high for the TSC and 1. CSC portfolios. Furthermore, also here only the cross-sectional portfolios are likely to break correlations between the futures. Over this sample, correlations are the lowest among the futures traded upon the 2. CSC.

When regarding the portfolios over the two large decreasing interest rate periods, some patterns are recognizable. Those futures traded according to either TSC or TSV are the only ones to at least partially outperform their buy-and-hold equivalents when regarded in isolation and accounting for risk. However, despite some few exceptions, the future returns are insignificant during both periods, indicating that the future performances do not come along primarily due to trading the signals corresponding to the investment styles. On a whole portfolio level, the two investment styles induce the highest performances within both a risk-non-adjusted and risk-adjusted framework and when traded in isolation or together. Even more remarkable, over both the in- and out-of-sample, both portfolios achieve to outperform the B&H when accounting for risk, independently of whether applied alone or together. Moreover, a negative relationship between the overall performance of carry/value and momentum portfolios is observable under a decreasing interest rate environment. While over the in-sample the whole period performance of the portfolios traded according to TSM or CSM are negative and that of the time- and cross-sectional carry/value portfolios are positive, during the out-of-sample such negative relationship is only visible between the time-serially traded portfolios. Even though they may perform in contrary direction, as visible in tables 63 to 78, on pages 137 and 138, while carry and value portfolios are positively correlated, with the highest correlation when both weighted time-serially, both carry and value are uncorrelated to momentum portfolios. Only the correlation between TSC and TSM is positive and partially high. Lastly, all carry portfolios achieve to gain a positive carry over both large periods. In recent years yield curves in the US and EU have

been positively sloped most of the time, whereas inverted only in the rarest case. The overall structure of the yield curves over the recent years may be well reflected by the carries gained by the long-only portfolio. As visible in table 49, the buy-and-hold portfolio achieves to gain a positive carry on all futures and over both periods. Among carry portfolios, over one sample it is the time-serially weighted portfolio that gains the highest carry, whereas over the other it is rather a cross-sectionally weighted one. Moreover, only within the in-sample do all carry portfolios gain a higher carry than the buy-and-hold portfolio. This finding may indicate that yield curves may have been more subject to partial inversions over the in- than over the out-of-sample. It is further noteworthy that among the US and the EU futures, over both periods, comparatively high carries can be gained on the ten- and thirty-year futures, while partially also on the three-month.

3.2.2.2. Increasing Interest Rate Environment

As outlined in chapter 1, increasing interest rate periods are represented by the inverted time-series of the in- and out-of-sample. The inversion of such implies treasury rates and futures prices to change. Within the inverted in-sample, the number of futures whose performance exceeds that of those included in a buy-and-hold portfolio, is high independently of the weighting method or the investment style pursued. This is observable on the futures ranking, table 35, on page 116. Latter may show that under an increasing interest rate environment, it may not depend on which investment style is pursued, as long as the strategy allows for going the futures long and short. However, also here, the significance of the futures' returns is not consistent; sometimes being highly significant and other times highly insignificant. When regarding the portfolios as a whole, it is visible that except for the portfolios traded according to either the 2. CSC or CSV, all single portfolios perform negatively over the whole inverted in-sample. However, analogous to what observable on table 35, the B&H portfolio achieves the highest loss before accounting for risk. Therefore, while the 2. CSC and CSV are the only portfolios to perform positively within this increasing interest rate period, all investment styles and weighting methods induce a higher return than holding the futures long throughout. The long/short strategies outperform the buy-and-hold strategy even when accounting for risk. The fact that the B&H portfolio's performance is negative is anything but surprising, as under an increasing interest rate environment bond prices may decrease due to the negative effect that increasing interest rates have on them. As visible in table 49, over the inverted in-sample, the B&H portfolio is even subject to a negative effect from the negative carry returns. Among carry portfolios, that traded according to the 2. CSC performs best. However, as visible in table 49, its carry gain is not the highest. It is rather the portfolio traded according to the 1. CSC that gains the highest carry over the inverted in-sample. Latter makes out more than twice the carry gained by the 2.

CSC portfolio. More importantly, all carry portfolios achieve to gain a positive carry, whereas the B&H portfolio does not.

As under a decreasing interest rate environment, the portfolio based on the investment styles carry and value together outperforms all other portfolios traded upon several investment styles when accounting for risk. The corresponding performances and volatilities can be gathered from table 41, on page 118. Even though its performance is worse than that of the other time-serial investment style combinations, it is subject to a more considerable volatility, what in turn results in a higher Sharpe ratio. While all portfolios achieve a lower negative performance than the B&H portfolio, when adjusting for risk only the combinations of TSC and TSV, as well as TSC and TSM are better off.

With regard to the correlations between the portfolio constituents, the picture is similar to that observed within the out-of-sample. Except for TSC, all other long/short strategies lead futures to be correlated to a lower extent as when included in B&H. Also, here are correlations the lowest among futures included in the 2. CSC portfolio.

Similar to what was observed within the inverted in-sample, over the inverted out-of-sample, under all investment styles a high number of portfolio components outperform the buy-and-hold equivalents. On an aggregated basis and independently of whether it is accounted for risk, the carry portfolios perform best. Furthermore, the cross-sectional carry portfolios are the only ones to perform positively over the whole period. As within the inverted in-sample, the B&H portfolio performs unsurprisingly negative. Different to what was observed over the in-sample, over this period the negative performance of the B&H portfolio due to increasing interest rates is partially offset by its positive carry gain. Even more remarkable is that also over this period all long/short strategies outperform the long-only strategy. Except for the portfolio traded according to TSM, this is also observable when accounting for risk. Also within the inverted out-of-sample do long/short carry strategies gain a positive carry. Now however, it is rather the 2. CSC portfolio that gains the highest carry. Moreover, only the 2. CSC and the TSC portfolios gain a higher carry than the B&H portfolio does.

Among the combined investment style portfolios, that traded upon TSC and TSV remains the best performer when accounting for risk. Similar to what was observed over the inverted in-sample, the combinations of TSC and TSV, as well as TSC and TSM achieve a lower negative performance than the B&H portfolio under both a risk-non-adjusted and risk-adjusted basis. Now, even the combination of all three investment styles achieves to do so too. These figures can be gathered from table 42, on page 118.

As within the in-sample, according to TSV, futures traded are not lower correlated as when included in the B&H portfolio. Similar to what was observed over other decreasing and increasing interest rate periods, only cross-sectional portfolios are likely to break correlations. It shall

be noted that this does not apply for the 1. CSC, which also here does not achieve to break correlations throughout. Once again, it is the 2. CSC and CSV portfolios that exhibit the lowest correlations among futures.

Similar to what was observed across the large increasing interest rate periods, over short increasing interest rate periods the number of futures likely to outperform the buy-and-hold relatives is high. Across the five short periods analyzed, long/short strategies generally outperform the long-only strategy. This can be observed in tables 25 to 33, on pages 114 to 116. Furthermore, it is noteworthy how also over shorter increasing interest rate periods the cross-sectional weighting of portfolio constituents results to be the best option. As visible in tables 26 to 34, the portfolios traded according to either CSV or 2. CSC perform best overall, while the momentum portfolios do partially well too. During the periods falling in 2003, 2004 and 2005, the CSV portfolio is the only one to achieve a positive performance. Over the period falling in 2006, it performs positive, while being outreached only by the portfolio traded according to 2. CSC. Only within the period of 2011 does the CSV portfolio perform negatively. During such, rather the momentum and the 2. CSC portfolios achieve to perform positively. On the other hand, the 2. CSC portfolio exhibits either the best or the second best performance throughout, sometimes not being able to be profitable. A possible reason for the latter working relatively well under the short increasing interest rate periods is its ability to gain a more positive carry as other investment style portfolios. As it can be gathered from table 49, over all five periods, the 2. CSC gains a positive carry, while the other carry portfolios and the B&H portfolio do not achieve to do so.

Whether under large or short increasing interest rate periods, the B&H portfolio performs negatively throughout and is generally outreached by all long/short strategies. It is noticeable that despite being able to gain a positive carry, under an increasing interest rate environment, long-only strategies are likely to perform negatively. The reason for this being the case is that positive carry gains may not be sufficient to offset the loss arising from increasing rates. Under an increasing interest rate environment, cross-sectional weighted portfolios perform better than time-serial portfolios. Among the former, especially the portfolios traded according to CSV or 2. CSC performs considerably better than their relatives. While the CSV portfolio performs positively and outperforms within the inverted in-sample and the short time-periods, the 2. CSC portfolio is the only one that achieves to perform positively within both the in- and out-of-samples. The performance of latter may be induced by the positive carry it gains throughout. Over all increasing interest rate periods, independently of whether the time horizon is large or short, the 2. CSC portfolio is found to gain a positive carry, whereas other long/short portfolios like those traded according to TSC or 1. CSC do not. Similarly to what was observed under a decreasing interest rate environment, while carry and value portfolios are either highly or slightly positively correlated, carry/value and momentum portfolios are rather uncorrelated. With regard to the correlations among the futures included in the same portfolio, across the short

periods it is observable that neither the TSC, TSV nor the 1. CSC portfolio exhibit overall lower correlations between the futures than the B&H portfolio does. Furthermore, it is recognizable that also across short-term periods, the 2. CSC and CSV portfolio are the only ones whose futures are not correlated with each other.

3.2.3. Interim Conclusion

Some investment styles and weighting schemes seem to work out better under a decreasing, while others rather under an increasing interest rate environment. While on one hand, the investment styles carry and value result to perform relatively well over large decreasing interest rate periods, over large increasing interest rate periods only carry does throughout. On the other hand, while an equally weighting of portfolio components results to be more beneficial during decreasing interest rate periods, during increasing interest rate periods it seems to be more favourable to trade only selectively and weight these components greater, while remaining non-invested in comparatively worse instruments. Under a decreasing interest rate environment, the portfolios traded according to either time-serial carry, time-serial value or both together achieve to outreach the buy-and-hold portfolio. As visible on table 43, page 118, they achieve to do so over both the in- and out-of-sample. Nonetheless, it shall be noted that on a whole, the futures returns are highly insignificant. This indicates that the futures performances may be more a result of luck than a consequence of trading the signals. When comparing the carry portfolios with each other, it is recognizable that the portfolio with the highest portfolio carry is not always the one with the highest portfolio performance. Furthermore, it can be observed that the long/short carry portfolios may not always gain a carry higher than that of the B&H portfolio. Latter contradicts the findings of Koijen et al. (2012), who find carry returns gained by long/short strategies to be higher throughout. On the other hand, it can be observed that carry trade portfolios at least achieve to gain a more positive (less negative) carry over periods where the B&H gains a negative carry. While long/short strategies may gain equally high or even somewhat lower carries than a long-only strategy in case of yield curves being positively sloped, the opposite may be the case the more likely yield curve inversions are. Latter can be explained by the fact that long-only strategies are not able to profit from such uncommonalities, whereas long/short strategies are due to their ability to go short instruments, whose carry is negative. Among carry trade portfolios, the 2. CSC portfolio gains a positive carry independently of the period's length or interest rate environment and under latter its overall performance is even higher than that of the B&H portfolio.

Other than Asness, Moskowitz and Pedersen (2013) who find their CSM and CSV portfolios to be negatively correlated during the time-period between 1982 and 2011, the CSV and CSM portfolios tested here are uncorrelated independently of whether they are regarded over a decreasing or increasing interest rate period, a short or long-term time horizon. Furthermore, while

they find evidence for directional value and momentum portfolios to perform better when applied together as when applied in isolation, this study finds rather the TSV when applied in isolation to perform best. Different to Koijen et al. (2012), who find CSM to have a negative effect on TSC when regressed with each other during the period extending from 1998 to 2011, the correlation between the daily returns of the TSC and TSM portfolios tested here is rather near to zero. Also here, this finding is applicable to both a decreasing and increasing interest rate environment. Another finding that cannot be confirmed based on the observations made in this study is that of Baz et al (2015) that among the cross-sectional portfolios, carry-only portfolios outperform both value and momentum under a decreasing interest rate environment. This study does not found evidence for one of the cross-sectionally weighted investment styles to the better option neither under a decreasing nor an increasing interest rate environment. Similar to what claimed by Baz et al (2015) correlations between carry and value portfolios are positive. However, levels similar to those of Baz et al. (2015) are visible only between TSC and CSV, as well as between 1. CSC and CSV over the inverted in-sample or between 2. CSC and CSV over the short time-period extending from June 16 to September 2, 2003. Correlations between carry and value are otherwise higher independently of whether time-serial or cross-sectional traded portfolios are compared with each other. Even though in average a higher positive correlation is observable, during some periods correlations are considerably lower, reaching levels similar to those of Baz et al. (2015) or result even to be negative, as the relationship observable between the TSV and the 2. CSC portfolio over large decreasing and increasing interest rate periods. On the other hand, while Baz et al. (2015) and Asness, Moskowitz and Pedersen (2013) find the correlation between their value and momentum portfolios to be slightly positive and negative respectively, the daily returns between time-serial and/or cross-sectional momentum and value portfolios are rather uncorrelated. Latter is also applicable to the returns between carry and momentum portfolios, what is consistent to the findings of Baz et al (2015).

Among the portfolios traded upon several investment styles and in a time-serial context, the portfolio traded upon TSC and TSV signals outperforms all other portfolios under both a decreasing and increasing interest rate environment. This observation is consistent with the finding of Baz et al (2015) who find the same combination of investment styles to outperform all others under a decreasing interest rate environment. This study further shows that the TSC and TSV combination achieves to outperform the B&H portfolio during decreasing and increasing interest rate periods. From the observations done on the correlations among the futures included in single long/short portfolios, it may be concluded that while almost all long/short strategies reduce the correlations between portfolio components over large time-periods, fewer do so over short-term periods. Moreover, while observations differ between shorter and larger time-periods, no distinction can be made between decreasing and increasing interest rate environments. Over larger time horizons, the TSC and the TSV portfolios exhibit slightly lower correla-

tions than the B&H portfolio, whereas across shorter time-horizons, futures traded according to either TSC, TSV or 1. CSC exhibit correlations as high as those of the long-only strategy. Furthermore, it is observable that independently of whether observed over a short- or long-term period, only the cross-sectional portfolios, with exception of the 1. CSC portfolio, are likely to break correlations. This finding is not surprising, as within cross-sectional portfolios only a few futures are traded at a time.

So far, observations were done on gross returns only. However, when accounting for transaction costs, things get clearer. As visible on table 48, on page 125, over both decreasing interest rate periods it is the TSV portfolio which performs best when charged. Latter achieves to do so due to the fact that allocation decisions are taken with a lower frequency when compared with the TSC or the combination of both. While it achieves to outperform the B&H portfolio within both the in- and out-of-sample when charged with costs per trade of 0,01%, it achieves to do so only within the in-sample when accounting for transaction costs of 0,02%. In case costs per trade amount to 0,03% or higher, the B&H portfolio becomes the better option. This finding may be also valid under an increasing interest rate environment, as within latter the risk-adjusted excess performances of the outperforming investment styles when compared with the B&H portfolio, are of similar size as their risk-adjusted excess performances during decreasing interest rate periods. However, this is of less importance as both the TSC and TSV portfolio perform negatively over increasing interest rate periods. Over latter, transaction costs were considered only for the 2. CSC portfolio, which results to be the only portfolio that performs positively over both periods observed. The reason for the Sharpe ratios of the 2. CSC portfolio becoming that negative is that the strategy rebalances the holdings in a high frequency, inducing high amounts of costs.

3.3. Further Trading Tools

3.3.1. Probability of Monetary Policy Actions

This examination aimed to test the effectiveness of the tool in anticipating future rate shifts. Consistent with Carlson, McIntire and Thomson (1995) and Robertson and Thornton (1997), in this study future federal fund rate shifts were estimated based on the thirty-days Federal funds future mostly one-month ahead. However, in some cases, this was done within the same month the contract was due. Estimations were not done more than one month ahead as the instrument loses in power of prediction the farer away it gets from the contract maturity. Latter is confirmed for instance by Carlson, McIntire and Thomson (1995) or simply by the industry who primarily relies on this contract for estimating future shifts. Furthermore, it shall be noticed that the predictions on potential federal fund rate changes conducted in this study are limited to whether the Fed leaves the rate unchanged, increases or decreases it by not less and not more than 25 basis points. In case of a wider range of possible rate shifts, the formula used here may

not hold. Data on the actions were gathered from the official site of the *Board of Governors of the Federal Reserve System* and for the periods ranging from 1990 and 2008, as well as from 2015 to 2016. Other as the other sub-studies conducted in this work, where the tools were tested directly as triggers in a portfolio context, this analysis consisted in first identifying whether the Federal funds future does at all provide accurate information on future monetary policy actions. This was done just by comparing the implied rate with the effective rate shift. Only if meaningful, the probabilities would have then been tested as triggers within a portfolio framework. Another important implication is that none of the actions falling exactly on the last day of the month were accounted for, as in such cases the formula applied here does not work properly.

For illustration, assume the next FOMC meeting to be on July 6, 2017 and the federal funds rate to be at 0,50% one month before, on June 1st, 2017. On this day, you want to know whether the FOMC will keep the rate unchanged, increase it or decrease it. Obviously, it cannot be known in advance what move the Federal Reserve will undertake on July 6, 2017. However, what can be done is to compute the probabilities of these events happening through the expectations implied in the federal funds futures price. In addition to the assumptions taken so far, assume the federal funds futures to trade at a price of 99.47 on June 1st, 2017. As the futures price implies a federal funds rate of 0,53 (100-99,47), in a first step you can estimate the rate to be kept unchanged than to be raised to 0,75%, as it is very close to the actual rate. In a second step, the probabilities for the FOMC to do the one or the other can be obtained through solving the following equation:

(29) $$current\ rate * \left(\frac{number\ of\ days\ at\ current\ rate}{total\ number\ of\ month\ days}\right) + [(new\ rate * p) + current\ rate * (1-p)] * \left(\frac{number\ of\ days\ at\ new\ rate}{total\ number\ of\ month\ days}\right) = implied\ rate$$

Where p equals the probability of a rate change and $(1-p)$ the probability of no rate change. Using the numbers of the example illustrated above, the equation looks as follows:

$$0{,}50\% * \left(\frac{6}{31}\right) + [(0{,}75\% * p) + 0{,}50\% * (1-p)] * \left(\frac{25}{31}\right) = 0{,}53\%$$

While the fraction $\left(\frac{6}{31}\right)$ equals the ratio between the number of days in the month of July during which the current rate 0,50% is known to remain unchanged, the fraction $\left(\frac{25}{31}\right)$ represents the portion of days in the month July for which the rate level is not yet known (Chicago Board of Trade, 2003, p. 11). Solving this equation would then result in the probabilities of the rate being changed or remaining unchanged to be 14,88% and 85,12% respectively (Chicago Board of Trade, 2003, p. 11).

Apart from taking the thirty-days contract to conduct such predictions, the reliability and accuracy of the estimation highly depends on the futures month price that is regarded. Generally, for

FOMC meetings falling in the first half of the month, the futures contract for that specific month should be considered, whereas for FOMC meetings falling in the second half of the month, rather the futures contract of the following month should be regarded (Chicago Board of Trade, 2003, p. 13). One important implication of this investigation is the use of the continuous future, as this tool is tested back in time. As no current futures are used and therefore no distinction among contract months can be made, the implied rates/probabilities are regarded at most up to thirty days before the action. More specifically, when the action falls in the first half of the month, the implied information is examined during the second half of the month prior to the action's month, whereas when the action occurs in the second half of the month, the implied information is regarded during the first days of the same month.

When applying this tool, it is visible that in most cases, the implied rate does not resemble the level of the effective current rate. This in turn leads to extremely high and therefore unreliable probabilities. In order to counteract this issue, in a second step, the implied rates and correspondingly the probabilities were adjusted to more meaningful levels. This has been done by equalizing the implied rate of the continuous future to the effective current rate after every FOMC decision. Even though after doing so the implied rate takes up a level similar to that of the effective Federal funds rate, as a consequence, the implied rate newly just fluctuates around the new effective Federal funds rate, providing no indications for future shifts. As it is recognizable on tables 79 and 80, pages 139 and 140, while the tool does manage to at least partially provide correct signals when implied rates are left unchanged, it does not at all after adjusting the implied rates. For illustration purposes, just the first observation made before the action date is listed. The remaining observed values between the first observation and the monetary policy action are not shown, as these do not vary greatly from the first values observed. As this tool does not seem to work well as a predictor of future open market operations, it has been refrained from testing the probabilities as signals within a portfolio framework.

3.3.2. Implied Inflation Rates

As inflation is considered an important component driving interest rates, by raising them when it increases and lowering them when it decreases, it seemed reasonable to regard the expectations on future inflation as possible indicator for the future development of treasury security futures. The effect current inflation has on bond futures is tested in section 3.3.4., when trading the futures according to information from CPI and PPI reports. As introduced in section 2.3.2., inflation expectations can be gathered from both break-even and inflation swap rates. As these may deliver different results, both sources were considered. This sub-study examined the effectiveness of market implied inflation expectations as signals for the future development of interest rate securities using rates and trading instruments from the US only. Moreover, the time horizons covered here ranged from the short- to the long-term. More precisely, similarly to

Kwan (2005), expectations on mid- and long-term inflation are represented by the five- and ten-year future inflation expectations respectively. However, unlike Kwan (2005), this study also includes expectations on inflation for shorter time-horizons, like the two-year expected inflation. While the short- (mid-) term inflation expectations were derived from the yield differences between the two- (five-) year conventional and the two- (five-) year inflation protected treasury notes, expectations on the long-term inflation were gathered from the yield difference between the five-year forward yield beginning in five years' time respectively. As described by Kwan (2005), the five-year forward yield is the difference between the yield implied between the five-year and ten-year conventional treasury securities and the yield implied between the five-year and ten-year TIPS. There was no need for computing the break-even rates, as these are directly provided by the database Bloomberg. Also in the case of inflation swaps there was no need for further computations or adjustments, as solely the rates were of importance.

On a whole, this study aimed to find out whether trading expected inflation can potentially lead to a better performance than pursuing a buy-and-hold strategy in equal terms-interest rate futures. In other words, expectations on the two-, five- and ten-year future inflation were used for trading the two-, five- and ten-year US t-note futures respectively. The effectiveness of trading inflation expectations was regarded within a long/short portfolio context. Therefore, in order to be able to trade inflation expectations, there was need for a technical analysis trading rule that allows for identifying when to go bullish and when to go bearish inflation expectations. As the purpose of this study was in a first instance to figure out whether such information is useful for trading, the signals were constructed only with the use of moving averages. Other technical trading rules were absolutely neglected. Overall, three sets of short and long simple, exponential and linear moving averages were first analysed visually in order to come up with that set that times breakouts in inflation expectations the best. Only that single set was then applied in a portfolio framework. The three sets 10/50, 10/200 and 50/200 were constructed using in-samples ranging from July 10, 2007 to December 31, 2012 for the break-even rates and from January 1st, 2013 to February 28, 2017 for the inflation swap rates. Among the three combinations, the 10/50 set manages to time the development of the inflation expectations better than either the 10/200 or 50/200 within the in-samples. Among the three moving average types in turn, no clear differentiation can be made by just analysing them visually. This is the reason why the 10/50 set was applied as a simple, exponential and linear moving average within a portfolio context and then compared computationally. As inflation has a positive effect on bond yields and consequently a negative one on bond prices, the trading signals were constructed such that the future was held long when expectations decreased and short when expectations increased. Technically, every time the short moving average crossed the larger moving average from above (below), a long (short) investment was done. As can be gathered from table 81, on page 141, within the in-sample the three moving average types perform rather differently de-

pending on the information source. When trading US treasury futures based on break-even rates, the 10/50 SMA performs best when applied on the two- and five-year t-note futures, whereas the 10/50 LMA when applied on the ten-year t-note future. However, none of the three moving average types achieves to outperform the buy-and-hold strategy within the in-sample. Whether break-even rates are used to trade short-, mid- or long-term futures, the underperformance of the moving average-based strategies is rather considerable. Moreover, the returns are in general highly insignificant, enforcing the unimportance of inflation expectations-based moving averages as of being useful at all as trading tools. When inflation expectations are traded based on inflation swap rates, the SMA achieves the highest performance only when applied on the two-year t-note future. When applied either on the five- or ten-years future, it is again the LMA, which leads to the highest risk-adjusted performance. However, only when applied on the two-year t-note future does trading the LMA lead to a statistically significant performance. Independently of the underlying instrument, none of the moving-average-based strategies leads to a risk-adjusted outperformance over the buy-and-hold strategy.

For purposes of robustness, the portfolios were also tested within an out-of-sample. While the portfolios based on break-even rates were regarded over the period between January 1st, 2013 and February 28, 2017, the portfolios traded according to inflation swap rates were analyzed over the period between January 1st, 2011 and October 26, 2016. When based on break-even rates, within the out-of-sample the picture is another, but still not promising. Also within this period does the SMA perform better than the LMA or EMA when applied on the two-year t-note future, but not when applied on either the five- or ten-year t-note futures, where it is rather the 10/50 EMA and the 10/50 LMA respectively, which achieve to do so. Again, the moving-average-based strategies generally do not induce a higher performance as just being long the futures. An outperformance over the buy-and-hold strategy is only realized by the SMA when applied on the two-year t-note future and by the SMA and LMA when applied on the ten-year t-note future. While the underperformances are now somewhat lower as within the in-sample, the few outperformances are either negligible.

As applied throughout the whole work, those tools that result to induce a performance higher than that of the buy-and-hold strategy are charged with transaction costs of one, two and three basis points. As visible on page 141, when doing so, the moving average-based strategies underperform the buy-and-hold strategy even when accounting for costs per trade of one basis point.

Overall, it is visible that independently of whether based on break-even or inflation swap rates, a short SMA-based strategy may perform better than either a short LMA or short EMA-based strategy when applied on the two-year t-note future, whereas when applied on the ten-year t-note future rather a short LMA. More importantly however, actively trading inflation expecta-

tions does only in the rarest case help to achieve a better performance than when holding a long position in the futures. This is perfectly reflected in the excess Sharpe ratios over the buy-and-hold strategy, which on a whole, are considerably negative. The ineffectiveness of trading treasury rate futures based on inflation expectations with help of moving averages is enforced by the high size of the reality check p-values too. Even though active inflation expectations trading may sometimes induce a performance higher than that of a passive long-only strategy under a gross return criterion, when accounting for transaction costs, the excess performance is negative. This is already the case when accounting for costs per trade of one basis point.

One possible explanation for the uselessness of market implied inflation expectations as triggers for bond futures trading might be that in this case not the current, but rather expectations on inflation are examined. While the former are a matter of fact, latter are rather market estimations of how inflation could look like in future. On the other hand, whether the current inflation results to be a more useful indicator will be examined later on when it comes to trading macroeconomic announcements. Another reason might be that the break-even and inflation swap rates are importantly affected by the inflation and liquidity risk premia, reflecting less changes in inflation expectations, but rather more changes in liquidity and uncertainty about future inflation. Advocates of the important effect inflation and liquidity premia on TIPS have been among others Christensen (2008) and D'Amico, Kim and Wei (2006) respectively. However, this issue seems not to be clear-cut, as other researchers such as Christensen, Lopez and Rudebusch (2010) or Christensen and Gillian (2011) in the sequel found evidence that erodes the size of the inflation and liquidity risk premia respectively.

3.3.3. Monetary Policy Actions

Up to the financial crisis, central banks have steered the economy primarily by changing the cash rate. However, with interest rates being near to zero from mid of 2007 on, the central banks of the United States, Europe, England and Japan have been trying to improve economic activity by increasingly undertaking LSAPs. Latter have been conducted with the aim of supporting the credit markets and reducing mid- to long-term treasury rates, consequently boosting real economic activity (Agostini, Garcia, Gonzalez, Jingwen, Muller & Zaidi, 2016, p. 12). An important implication of this move towards more uncommon practices for bond traders is that the two measures imply different effects on the yield curve. Conventional monetary policy actions, such as in- or decreases in the cash rate, have a considerable impact on the slope of the yield curve and therefore impact primarily short-term interest rates. When a central bank decides to raise (lower) its funds rate, short-term treasury interest rates are expected to increase (decrease) accordingly, thereby causing the price of the respective treasury bond to decrease (increase). On the other hand, LSAPs impact rather interest rates on the longer end of the yield curve and cause the prices of these bonds to increase.

3.3.3.1. Conventional Monetary Policy Announcements/Actions

This section aims to show whether actively trading treasury futures upon decisions on monetary policy decisions is more profitable than a buy-and-hold strategy. Furthermore, it is tested for the performance of the treasury futures not only when traded on the day when the announcement was made, but rather when the interest rates were effectively changed. Prior to conducting the analysis on conventional monetary policy announcements and effective changes as potential trading tools, it is assumed that bond futures with maturities up to two years will react stronger to conventional monetary policy actions than longer-term futures. In contrast to other analyses, where the performance of the underlying trading tool was tested on an out-of-sample, here it is refrained from doing so, as the observed monetary policy decisions are limited. The effect of conventional monetary policy decisions on treasury futures is observed over a large time horizon as well as across five different short time-periods. The short periods fall in the in-sample and are chosen randomly. The investigation is done for the US, European, Australian, Japanese and British market. Therefore, the negligence of an out-of-sample does not question the robustness of this study at all. For the European Union, it is accounted for two out of three existing cash rates, being the deposit facility rate and the Main Refinancing Operations (MRO) rate. While the former represents the rate that banks gain from depositing cash within the ECB overnight, second is the rate at which banks can borrow money from the ECB for a period of one week (European Central Bank, 2016). Changes in the deposit facility rate are regarded over the period extending from November 1999 to March 2016, whereas changes in the MRO rather between July 2008 and March 2016. For all other markets, the periods range between June 1999 and December 2016 and between February 2001 and January 2016, being the largest and shortest periods respectively. Historical cash rate changes are extracted directly from each central bank's website. Furthermore, the exact dates on which the interest rate decisions were first publicly announced are extracted from the corresponding monetary policy statement, also to be found in the archive of each central bank's website. Futures are traded long when the central bank decides to lower the cash rate and short when it decides to raise it.

According to Gürkaynak, Sack and Swanson (2004), open market operations per se may not result in good trading signals, as changes in interest rates may be anticipated by the market to a high extent. However, this perception in turn is questioned by the analysis conducted on the federal funds future in section 3.3.1., whose implied rate did not result to be a reliable basis for the estimation of future policy actions. Another finding that questions the anticipation of interest rate changes is that of Wu (2001). He finds conventional monetary policy actions to have a short-lived effect on short-term rates. Therefore, this analysis shall either confirm or disapprove the findings of Gürkaynak, Sack and Swanson (2004) when trading short- to long-term sovereign bond futures in a portfolio context.

When looking at the US market, where over the last seventeen years interest rate announcements on behalf of the FOMC have had an immediate effect, it is visible that over the whole period short-term futures with maturities up to two years exhibit Sharpe ratios considerably higher than those of long-term futures with maturities of ten or thirty years. While among them the three-month t-bill future results to be the outperformer with a Sharpe Ratio of 0,93944, the thirty-year t-bond future results to be rather the underperformer with a risk-adjusted performance of 0,19438. The futures returns are all significant at a 95% confidence level, showing that returns might arise mainly from trading increases and decreases in the federal funds rate. Also remarkable is that the reality check p-value gets higher the larger the maturity of the future. In other words, returns are found to be the less significant the higher the maturity of the traded future. This again might enforce the matter that the effect of conventional monetary policy actions on futures prices might be the greater the shorter the maturity of such. When looking exclusively at those short periods for which most returns result to be significant at a 98% level, being those ranging between January 15 and March 9, 2001 as well as between October 18 and December 12, 2002, it is observable that the three-month t-bill future again exhibits the highest risk-adjusted performance, followed by the two-year t-note future. On the other hand, over the periods extending from January 14 to March 9, 2000 and from October 15 to December 7, 2007, the three-month t-bill future is outreached by the longer-term t-note/bond futures. Nonetheless, other as the longer-term futures, the three month t-bill future returns are highly insignificant, indicating that the performance may not arise due to trading interest rate decisions. When compared with the buy-and-hold strategy, on a whole, the futures' performances are at most similarly high. Among the six futures examined, only the three-month t-bill future achieves to outperform the buy-and-hold strategy. It does so over the large period as well as over one short time-period. Across all other short time-periods it performs equally or even worse. When comparing the performances of shorter- with longer-term bond futures during shorter time periods, no clear patterns are observable. While the three-month t-bill and the two-year t-note futures outperform treasury futures of larger maturities through the whole period, they do so during short time-periods only three out of five times.

For the European treasury bond market it needs to be differentiated between the influence of monetary policy announcements on treasury futures on the one hand, and the influence of effective interest rate changes on treasury futures on the other hand. Different to what observed in the US market, announcements/decisions on interest rate changes have had an immediate effect only in the rarest case. As tables 84 and 86, on pages 144 and 146 shows, since 1999 interest rate decisions have been implemented only two times with an immediate effect. Before March 10, 2004 (European Central Bank, 2017b) decisions have been realized one day after the announcement, whereas from then on, even one week after the announcement. As outlined in the introduction to this section, European t-bond futures were traded upon two different cash rates,

the deposit facility rate as well as the MRO rate. As illustrated by table 85, on page 145, also when trading European treasury futures upon announcements on the deposit facility rate, the three-month t-bill future would have induced the highest performance. Also here, the outperformance over futures with larger maturities is rather considerable. While its risk-adjusted performance amounts to 0,84138, that of the second best performing future, being the ten-year t-note future, amounts only to 0,42093. Furthermore, only the trading of the three-month t-bill future is more profitable than being passively invested in the respective future throughout. Similarly to what observed in the US market, trading the three-month t-bill future seems to be the best option over large, but only partially across short periods. It may be furtherly noted that trading announcements on changes in the deposit facility rate may not be primarily responsible for the performances observed here. As table 85 shows, over the large period none of the futures performances is significant at the 90% level. In a next step, it can be examined whether trading treasury futures based on announcements on interest rate changes results to be more profitable than trading them once the rate is effectively changed. When comparing the results of tables 85 and 87, it is worth noting that trading the three-month t-bill or two-year t-note future already when the first announcement is done, induces a higher performance than when trading them not before the decisions are implemented, whereas the opposite is the case for futures with larger maturities. It may be furtherly noted that the performance of futures traded upon announcements is statistically somewhat more significant than that from futures traded not before the day of change. While trading the three-month t-bill future according to announcements on changes in the deposit facility rate results to be more profitable than both trading the future not before a change is reality and pursuing a buy-and-hold strategy, it begs the question how profitable such strategy may be when considering the MRO as underlying rate. Now, the outperformance of the three-month t-bill future over futures with larger maturities results to be even higher, but at the same time, returns are even more insignificant. Furthermore, over the whole period, all futures are clearly outreached by the buy-and-hold strategy. Similarly to what observed when using the deposit facility rate as underlying rate, when trading futures not before the decisions are implemented, the performances are worse for the three-month t-bill and two-year t-note futures, whereas better for futures with larger maturities.

Among the two Australian bond futures, which take on the maturities of three months and ten years, the short-term future outperforms the long-term one during the whole period independently of whether traded upon announcements or effective changes in the cash rate. Also similar to what observed in the US and European market, only the three-month t-bill future achieves to outperform the buy-and-hold strategy. Furthermore, trading the Australian three-month t-bill future once the central bank's interest rate decision is first disclosed to the public is more profitable than doing so not until the day of implementation. However, against what observed so far, the returns gained when trading the future upon announcements is considerably

less significant than the returns gained when trading the future upon effective changes. When traded according to announcements, the return gained on the three-month t-bill future is even less significant than the return gained on the ten-year t-note future, what does not indicate that the short-term future may be more prone to changes in the interest rate.

Similar to the Australian treasury bond market, also the Japanese market was analyzed according to the performances of the three-month t-bill and ten-year t-note future. During the whole period, the performances however, are found to be reversed. While in the US, European and Australian markets the three-month t-bill future achieved a positive as well as the highest Sharpe ratio when compared to futures on the long end of the yield curve, in the Japanese market exactly the opposite is visible. However, it shall be noted that here the performances of both futures are highly insignificant. Over some shorter periods, the three-month t-bill future performs better than the longer-term one, but during others, it performs worse. Furthermore, it may be noticeable that the significance of the futures' performances vary substantially, providing no patterns of whether trading the open market operations is worth for the one or the other or for anyone at all. When compared with the passive long-only strategy, the three-month t-bill and the ten-year t-note future underperform. Independently of whether the Japanese futures are traded either according to announcements or to the effective changes, over the whole period examined here, the performances are rather similar.

Lastly, the same was applied for the gilt future of the United Kingdom. As for the US, here no distinction is needed between dates of announcement and dates of implementation, as in recent years, interest rate decisions have had an immediate effect. Over the whole period, the long gilt future is found to considerably underperform the buy-and-hold strategy. This is not surprising, as this future has rather a large maturity and therefore other than a three-month future, may be subject to interest rate decisions to a significantly lower extent. Latter is again enforced by the high insignificance of the returns.

On a whole, it is visible that trading conventional monetary policy decisions is the more profitable the shorter the maturity of the underlying future. When examined over large periods, US, European and Australian short-term futures with maturities of three months and two years outperform futures with larger maturities. This finding is consistent with that of Wu (2001) that interest rate decisions affect points on the short end of the yield curve the most. For the US, this finding can be further enforced by the size of the reality checks' p-values, which result to be the lower the shorter the maturity of the future. On the other hand, the consistent outperformance of the three-month t-bill and two-year t-note future is not always given when analyzed across shorter time-periods. All these observations are valid independently of whether interest rate decisions are traded on the day when first announced to the public or on the day when implemented. The main finding from the distinction between trading the future on announcement

days and on days of implementation is that over larger periods, doing former results to be more profitable. However, as the analysis of the European market shows, it may be more profitable to do so only when trading short-term futures. As visible on tables 85 and 87, independently of whether the deposit facility rate or the MRO rate is used as trading indicator, the Euribor three-month and the Euro-Schatz two-year future perform better when traded on announcement days rather than on days of implementation, whereas the opposite is the case for longer-term futures. Despite the difference in performance between doing the one or the other, both approaches are found to lead the three-month t-bill futures of the US, Australia and the EU, latter only when based on the deposit facility rate, to achieve a higher risk-adjusted performance than a buy-and-hold strategy over the large period. This is even valid when accounting for transaction costs. As visible on table 98, on page 153, the Euribor and Australian three-month futures outperform the long-only strategy even when costs amount to three basis points per trade, whereas the US future underperforms the buy-and-hold strategy only in case costs were higher two basis points per trade. The outperformance of the Euribor and Australian three-month futures over the buy-and-hold equivalent after transaction costs is given even when traded not before the rate is effectively changed. Despite these promising results, it shall be noted that the performance of the three-month future is not significant for all markets and all underlying cash rates. This is exclusively the case for the US and the Australian three-month futures when traded on the day of implementation. This study further confirms the findings of Gürkaynak, Sack and Swanson (2004), who show that many FOMC decisions do not come up as surprises when examining the US three-months t-bill future, and extends this observation to further markets. It shows that the anticipated effect of interest rate decisions on futures prices may be applicable also to interest rate decisions on behalf of other central banks like ECB, RBA or BOJ. Table 82, on page 142, shows the percentual change of the US three-month t-bill future on the day of announcement, on the day following the announcement, as well as over the whole period up to the following announcement. As recognizable on such, the future's price does not always close higher (lower) on the day of an announcement than on the previous day, when the FOMC decides to decrease (increase) the federal funds rate. It is further observable that before the financial crisis, such contrary developments of the futures price were more likely, the lower the extent to which the interest rate was changed. This is perfectly visible when comparing the futures price development upon changes of 25 and 50 basis points on announcement days falling before the financial crisis. During latter however, such distinction is not valid anymore. For instance, on March 18, 2008, when the federal funds rate was lowered by 75 basis points, the three-month t-bill future closed at a lower price than the day before. This was also the case on October 8, 2008, when the FOMC decided to decrease the rate by 50 basis points. As table 82 shows, the development of the futures price is even more inconsistent when regarded over a larger period following the announcement. A similar picture is observable when conducting the same analysis for the Euri-

bor three-month future. Independently of whether changes in the deposit facility rate or the MRO rate are examined, and whether interest rate decisions are regarded on the day of an announcement or the day of implementation, the futures price does only partially develop in the direction it would be expected to. Such inconsistencies are observable not only when considering the one-day development between the closing on the day of an announcement and the closing of the previous day, but also when regarding the futures' price development between announcements. The same is also observable when considering the Australian or the Japanese three-month future.

3.3.3.2. Unconventional Monetary Policy Announcements

While interest rate decisions allow for establishing trading signals rather easily, this might not be the case when considering non-standard monetary policy actions. As in recent years central banks have known only one direction, which has been to increasingly put pressure on the long-end of the yield curve and therefore decrease long-term interest rates, trading unconventional monetary policy announcements alone would have led to long investments into longer-term treasury futures throughout, resembling nothing else than a long-only strategy. However, as these non-standard monetary policy actions may not have always led long-term yields to decrease at the desired pace and/or to the desired level, this study first examines the effect of each single QE measure on long-term interest rates out of a portfolio context. In a further step, it is also accounted for the effect of QE measures on the countries' credit risk. Latter is done with the aim of finding a possible interrelation between QE actions, long-term treasury rates and sovereign credit risk. Accordingly, the goal of this analysis is to figure out whether QE actions have effectively led long-term treasury rates as well as credit risk to decrease.

To date, many researchers have investigated the impact of QE on sovereign credit risk, coming to the conclusion that liquidity injections and credit risk are negative related to each other. In practice, a country's credit risk is generally measured with help of sovereign Credit Default Swap (CDS) spreads. Wong, Biefang-Frisancho, Yao & Howells (n.d.) examine the interrelationship between credit risk and liquidity risk premia for the three-month sterling for periods falling before the financial crisis, within the crisis but not subject to QE measures, within the crisis and prone to a QE regime and lastly after the financial crisis (p. 7). While credit risk premia is proxied by the countries' CDSs, the liquidity risk premia is proxied by the difference between the Libor and the overnight index swap (OIS) (p. 4). Overall, they find the correlation between the two to amount to +0,36 before the crisis, to increase to +0,65 during the crisis when no QE is conducted and to increase even further up to +0.71 during the crisis when the BOE conducts QE. On the other hand, they find the relationship to become negative after the crisis, amounting to -0,16 (p. 8). Fratzscher, Lo Duca and Straub (2014) investigate the impact of ECB unconventional monetary policy announcements and operations on global bond yields from

May 2007 to September 2012. They find ECB's unconventional monetary policy to be of global reach, while having the highest effect on distressed European countries. Bond yields of such countries are found to be lowered by the implementation of Outright Monetary Policy Transactions (OMT) and Supplementary Long-term Refinancing Operations (SLTRO), as well as announcements and implementations of Securities Market Programmes (SMP) (p. 3). Albu, Lupu, Calin & Popovici (2014) find quantitative easing actions on behalf of the central banks of Europe, England, United States and Japan to impact the credit risk of nine European countries, mainly situated in the center and eastern part of Europe. Evidence for an interrelationship between QE measures and sovereign credit risk changes is found over the period between beginning of 2005 and mid of 2013 (p. 43). They find German credit risk, implied in its sovereign CDS, to react more sensitive to QE actions leading to a decrease than to those leading to an increase in risk. Among the nine European countries, they find German credit risk to decrease the most upon QE actions (p. 44). Furthermore, they find the observed countries' credit risk to react the most to unconventional monetary policies on behalf of the ECB, BOJ, BOE and Fed in decreasing order (pp. 44-47). Pelizzon et al. (2014) examine the effect of ECB's unconventional monetary policy announcements/decisions on Euro-zone countries' credit risk and bond market liquidity (p. 25). Besides finding evidence for CDS spreads and bond market illiquidity to have decreased after the EBC announcement on the long-term refinancing operation (LTRO) of December 8, 2012, they highlight in particular the importance of the level in credit risk when it comes to the relationship between credit risk and bond market liquidity. While they find the bond market liquidity to have increased significantly after the ECB intervention, they find the relationship between credit risk and bond market liquidity to be weaker afterwards (p. 32).

Different to major research, this study proxies sovereign CDS spreads by the countries' investment grade corporate credit indices. Latter represent the average CDS spreads of corporations with low risk of default. The consideration of corporate instead of sovereign CDSs is done due to the fact that the single countries' sovereign CDSs are not publicly available. According Haerri, Morkoetter & Westerfeld (2014) who investigate to what extent the creditworthiness of a country and the creditworthiness of its local companies are related to each other, sovereign CDSs may be well proxied by corporate CDSs (p. 2). Haerri, Morkoetter & Westerfeld (2014) analyze the CDS spreads of 107 European companies from ten different countries over the period ranging between January 2009 and December 2011 (p. 3). They find evidence for sovereign and corporate CDS spreads to be positively correlated. However, the correlation is found to be just of the size of 0.4676 (p. 32). They further find the correlation to be significantly higher for distressed countries and under crisis situations. Among others, Longstaff and Schwartz (1995), Duffee (1998), as well as Naifar and Abid (2005) find the relationship between credit spreads and government bond yields to be negative. The former conclude this from analyzing the relationship between the US thirty-year t-bond rate and investment grate corporate credit

spreads (p. 810), Duffe (1998) does it based on the US three-month t-bill rate and bond yield spreads of investment grade corporations (p. 2232), whereas Naifar and Abid (2005) on the US and French three-month t-bill rates and CDS spreads from many European countries. Besides finding the treasury rates and the CDS spreads to be negatively related, they come to the conclusion that the determining power of treasury rates on CDS spreads depends on the economic condition of the country. For instance, they find the explanatory power of the US t-bill rate not only to be substantially lower than that of the French t-bill rate, but also insignificant (p. 12).

Different to short-term futures, whose price is highly prone to changes in the cash rate, long-term bond futures, with maturities of ten and thirty years, are rather subject to unconventional monetary policy measures like QE. This study investigated whether announcements on latter have had affected long-term treasury rates since its implementation in the financial crisis. This was done by first accounting for the interest rate change between the day before the announcement and the day of the announcement and second by taking into consideration the further development of the treasury rate, on the day after the announcement and until the following announcement. While for the US, Germany and the United Kingdom the potential effect of QE was regarded for the respective ten- and thirty-year t-note/-bond rates, for Japan it was done only for the ten-year t-note rate. As visible on table 99, page 153, where the content of the announcements on behalf of the FOMC are listed, those announcements which consisted in no new measures, but rather a confirmation of previous decisions were denoted with “Status Quo Ante”. Latter was applied solely for the US, as all announcements from December 17, 2014 on consisted in maintaining the previously pursued monetary easing strategy without undertaking any new measures. At the same time, accounting for such announcements enables to detect whether the behavior of long-term treasury rates is different as when following newly announced measures. In a further step, it was tested for a possible effect of QE measures on sovereign credit risk. Latter was proxied by the respective investment grade corporate credit index. The credit risk of European Union was proxied by the corporate credit index of whole Europe and of the Western part only. For the United Kingdom only the effect of QE on long-term treasury rates was accounted for, without taking further into consideration the credit risk perspective. The reason for doing so is the lack of data on sovereign CDS spreads or the corporate credit index before mid of 2012. Australia is not considered at all, as its reserve bank has not made use of this non-standard tool so far. The observed announcements lie between November 25, 2008 and February 1st, 2017 for the US, between August 28, 2007 (December 12, 2011) and December 15, 2016 for Europe (Western Europe), between October 5, 2010 and December 18, 2015 for Japan and between January 01, 2009 and August 4, 2016 for the United Kingdom. As for the analysis on interest rate decisions as potential trading tool, the dates and contents of the an-

nouncements on QE were extracted directly from the corresponding central banks' press releases.

Up to the announcement falling on September 13, 2012, the US ten-year t-note rate declined on days were new QE decisions were taken, but only partially when announcements consisted in confirming the previously announced direction. Furthermore, it is recognizable that after announcements until the decision taken on September 21, 2011 inclusive, which led the US ten-year t-note rate to decline on the announcement day, the rate overall declined until the following announcement. On the other hand, just up to the announcement on September 21, 2010, the US thirty-year t-bond rate was affected in the same direction as the ten-year t-note rate on the announcement day, and for the large time-period before the following announcement only after the first two announcements in 2008. From 2013 on, where the FOMC has steadily reduced its asset purchase program (APP) until concluding it on October 29, 2014, US long-term treasury rates could not always be lowered afterwards. This was the case on March 19 or July 30, 2014, where the ten-year t-note rate increased by 1,91 and 13,23 basis points respectively. The effect of QE decisions on long-term treasury rates on the same day when announced was even more inconsistent, being more times positive than negative. After concluding the APP end of October, 2014, the FOMC kept pursuing its policy of reinvesting principal payments from its holdings in both agency bonds and agency mortgage backed securities (MBS) as well as rolling over long-term treasury securities (Federal Reserve, n.d.). The maintenance of this policy seems not to have put further pressure on long-term treasury rates as is visible on figure 6, page 155. Since then, long-term treasury rates have rather fluctuated. Over the whole period between December 17, 2014 and March 3, 2017, the ten- and thirty-year t-note/-bond rates have even increased by 34 basis points. With regard to US credit risk, no considerable relation with QE and interest rate changes is observable, either on the day of the announcement or between such. This inconsistent relationship is also reflected by the varying correlations between interest rate and credit risk changes between the analyzed QE announcements. Between latter, the relationship between the two is sometimes positive, negative, weak or more considerable. Over the whole period, the correlation between sovereign treasury rates and credit risk changes amounts to -0,4 independently of whether the ten- or the thirty-year t-note/bond rate is considered. As visible on figure 6, since the financial crisis long-term treasury rates have decreased, however most probably not to that extent and at the pace the FOMC may have wanted to. An important downward development of both the ten- and thirty-year treasury rates occurred after the announcements on November 25 and December 1st, 2008, when the FOMC first announced to purchase agency bonds, MBSs and long-term treasuries in big amounts. However, even more pressure could be put on long-term treasury rates after November 3, 2010 and September 21, 2011, when the FOMC decided to expand the purchase and enlargen the maturity of the existing holdings in long-term treasury securities respectively.

Even more inconsistent are the impacts of QE announcements on behalf of the ECB on German long-term treasury rates in the short-term and very short-term. As observable on table 102, on page 157, even on days falling within the financial crisis, on which US treasury rates resulted to react rather highly negative to liquidity enhancing decisions, there is no recognizable pattern when looking at the changes in German treasury rates on days of announcements. The picture is rather unclear also between announcements. As can be gathered from table 102, as expected, the German ten-year t-note rate decreased considerably after the ECB had announced to allot a three-month SLTRO of €40 billion on August 23, 2007 and to add a six-month and a further three-month SLTRO on March 28, 2008. However, after the ECB had disclosed its willingness to realize and prolonge a new and existing LTRO respectively, as well as to launch a covered bond purchase programme (CBPP), both long-term rates rather increased significantly. Not until the details on the CBPP were published, did long-term treasury rates decreased afterwards. That German long-term treasury rates developed positively after QE announcements was not only the case after May 7, 2009. Different to what observed in the US market within and shortly after the financial crisis, where treasury rates were likely to develop positively in case of announcements consisting in maintaining the policy pursued to that date, German long-term treasury rates increased even after the announcement on new liquidity enhancing decisions. For instance, this was the case after the announcements on May 9, 2010 or October 6, 2011, where the ECB decided to conduct a SMP and to launch the second CBPP (CBPP2) respectively. Similarly to what observed in the US market, the relationship between changes in German long-term treasury rates and European credit risk is negative, amounting to -0,38 and -0,42 when compared with the ten- and thirty-year t-note/-bond rate respectively. Different to what observed in the US market, the periods over which credit risk and treasury rate changes were positively related with each other, are even fewer in the German market. On the other hand, when compared only with Western European corporate credit risk, the relationship is also negative overall, however now the relationship is weaker. Over the large time-period extending from October 13, 2011 to March 3, 2017, the German ten- and thirty-year treasury rates correlated just at -0,2 and -0,17 with Western European credit risk respectively.

The BOJ announced to establish an APP not before October 5, 2010. This programme has consisted in buying large quantities of Japanese government bonds (JGB), Japanese t-bills, corporate bonds, exchange-traded funds and Japanese real estate investment funds (Bank of Japan, 2017). Over the years until end of October 2014, the BOJ then increased again and again the quantity of JGBs to be purchased. Overall, the periodic extensions of JGB purchases had a negative effect on the ten-year t-note rate. As recognizable on table 104, page 159, only after the announcement of the APP on October 5, 2010 and the disclosure of the details on the APP on October 28, 2010, did the ten-year t-note rate not develop in the desired direction afterwards. Similar to what observed in the US and European market, the very short-term effect and the

further development of the treasury rate do not coincide on the one hand, and on the other hand, the credit risk is lowered only in the rarest case. Also in the Japanese market, are credit risk and treasury rate changes negatively correlated overall. However, it is recognizable that the relationship is overall as low as between German treasury rates and the Western European credit risk and not as high as between German treasury rates and European credit risk or between US treasury rates and US credit risk.

Similarly to the BOJ, the BOE also steadily increased its purchases of government bonds within and over the years following the financial crisis. After its announcement on the set up of the asset purchase facility (APF) on January 19, 2009 and the decision to purchase £75 billion of gilts on March 5, 2009, over the few years up to mid of 2012 it expanded its gilt purchases again and again until reaching an APF value of £375 billion in gilts. Not before August 8, 2016, the BOE decided to extend its gilt purchases to a total value of £435 billion, which at the same time equals the actual value of the APF. As observed among the other treasury markets, QE measures on behalf of the BOE have not always led long-term treasury rates to decrease until a new monetary easing decision was due. This was especially the case during the financial crisis, as visible after the announcements on January 19 or May 7, 2009, where both the ten- and thirty-year treasury rates increased over the ten days and three-month periods respectively up to the next announcement. From 2010 on, QE measures seem to have had a higher downward effect on long-term treasury rates. This is visible between the last four announcements prior to that on August 4, 2016. However, the huge changes after February 4, 2010 or July 5, 2012 are to be judged with caution. It shall be noted that these two changes cover somewhat larger periods than the others.

Besides examining the relation of long-term treasury rates towards QE announcements on behalf of the corresponding central banks, it was further accounted for the global influence of monetary easing decisions on behalf of the FOMC. According to Rogers, Scotti and Wright (2014), QE announcements on behalf of the Federal Reserve influence German long-term bond yields. As illustrated by table 108, on page 163, equal to US bond yields, up to September 21, 2011 inclusive, the German ten-year t-note rate developed negatively after each announcement containing new measures. Afterwards, the German t-note rate developed only partially in the same direction as the US ten-year t-note rate did following US announcements. More remarkable is that some US announcements before 2011 may have impacted not only the US, but also the German ten-year t-bond yield to a great extent. This may have been the case after the announcements on November 25, 2008 or November 3, 2010.

The main findings of this analysis are rather of global than of country-specific nature. However, one meaningful country-specific finding may be the effectiveness of liquidity enhancing actions on behalf of the FOMC up to the second quarter of 2011 and of 2012, where the US ten-year t-

note rate decreased between announcements and on the day of the press release respectively. However, this observation is valid after new decisions were taken and not after the publication of announcements confirming the continuation of previously defined actions. In the aftermath, monetary easing actions on behalf of the FOMC seem to have loosened in effect within both the short-term and very short-term, causing long-term interest rates not always to decrease, either on the day of announcement nor over the period up to the following monetary easing decision. The inconsistency in the behaviour of treasury rates on the day of new QE measures is also applicable to Germany, Japan and the United Kingdom over the whole periods observed. However, with regard to the effect of QE measures on treasury rates between announcements, for Japan, after almost all announcements the ten-year t-note rate decreased accordingly. On the other hand, for the UK it is observable that decisions taken on behalf of the BOE from June 2010 on, seem to have put the expected downward pressure on long-term treasury rates as latter decreased between announcements throughout. The inclusion of the corporate credit indices has not resulted in clear pattern regarding the effect of QE decisions on the countries' credit risk. Consistent with the findings of Longstaff and Schwartz (1995), Duffee (1998) or Naifar and Abid (2005), over the whole periods, corporate credit spreads were found to correlate negatively with long-term treasury rates for all markets analyzed. However, accounting for the correlations between long-term treasury rates and the corporate credit index between QE announcements has allowed for identifying that the relationship between the two after monetary easing decisions can vary considerably in both size and sign. Furthermore, for all markets, neither on the day of an announcement nor between announcements could a clear connection between QE decisions and corporate credit spreads be found. Lastly, up to the third quarter of 2011 inclusive, it has been found evidence that enforces the finding of Rogers, Scotti and Wright (2014) that QE announcements on behalf of the FOMC may affect German bond yields. While within this period the German ten-year t-note rate was found to decrease between FOMC press releases containing new QE measures, such relation could not be observed in the aftermath.

3.3.4. Announcements on Economic Activity and Inflation

Releases on economic activity like reports on employment, GDP advance or durables goods orders have a positive effect on bond yields. On the other hand, announcements on initial jobless claims have the opposite effect, as an increase in such means lower economic growth and consequently lower bond yields (Goldberg & Leonard, 2003, p. 4). Strong (weak) economic growth indicators increase (decrease) the probability that the federal reserve increases interest rates in future and increases (decreases) the probability of inflation to rise (Kenny, 2017). Therefore, when trading bond futures, positive (negative) information on economic growth should be regarded as harming (favoring) for bond futures prices, as latter are eroded (enforced) through the impact such announcements have on bond yields. In addition to economic growth

indicators, it may be also useful to trade information on current inflation. As known, latter is a component of nominal bond yields and therefore evidently affects the price of bond futures too. Similar to economic growth, a rise in inflation has a positive effect on interest rates, whereas a decrease has a negative one. In turn, the price of a sovereign bond future is inversely affected, by increasing (decreasing) when inflation decreases (increases).

According to literature, this study considers those announcements that are perceived to affect bond yields the most, which are reports on employment, GDP advance, durable goods orders and initial jobless claims as economic growth indicators, as well as reports on CPI and PPI as inflation indicators. This study tests only the effect of announcements on behalf of the US government on US treasury futures. This restriction is done based on the finding of Goldberg and Leonard (2003), who examine the effect US and Euro area report releases have on each other. They find that US announcements significantly impact US, German and Euro area short- and long-term bond yields, whereas German and Euro area report releases do not impact US bond yields at all and German and Euro area bond yields to a significantly lower extent than US reports do. The effectiveness of such announcements as triggers for trading US treasury futures is first regarded separately and second when applied together. Latter is done, as reports on employment, CPI, durables goods orders and initial jobless claims are published on the same day., consequently not allowing to account for the effect of the single reports. When applied together, futures are traded only when announcements falling on the same day provide the same information about economic growth and inflation. The performances are always compared with that of a buy-and-hold strategy in the same future. This study considers short-to long-term US treasury bond futures with maturities of thirty days, three months, two, five, ten and thirty years. The reason why this study is not conducted just to a specific level of the yield curve, is that according to research, announcements seem to impact the whole yield curve. As all the reports are published monthly, with exception of the GDP advance reports which are published quarterly, the futures are traded according to monthly (quarterly) signals. Even though most reports are published at the end of the week, on Thursday or Friday, sometimes they are published on the non-trading day Sunday. In case of latter being the case, the announcement is perceived to be done one day after, on Monday. While within the portfolios traded according to employment, GDP advance and durable goods orders data, long US treasury bond future positions are held whenever the month-over-month change is negative when compared to the month-over-month change published one month before, a short position is held whenever this is positive. The same procedure is applied for the portfolios traded according to the CPI and PPI. Only initial jobless claims are regarded differently. In this case, futures are held long whenever the month-over-month is positive and short when it is negative, as an increase (decrease) means more (less) filings for unemployment, lower (higher) economic growth, lower (higher) bond yields and therefore higher (lower) bond prices. Researchers agree that announcements have a short-lived

effect on bond futures prices, as latter jump within the first fifteen minutes, when not within the first minute after the release. As the portfolios underlying this analysis are also based on trading the signals with one day of slippage, the portfolios are not assumed to profit from trading macroeconomic information as by then this will be already priced in. The portfolios were constructed based on an in-sample ranging from February 1st, 1999 to December 12, 2011 and tested on an out-of-sample extending from January 1st, 2012 to March 3, 2017, as well as five shorter time-periods falling in the in-sample. The in-sample falls shorter for the portfolios traded according to PPI and the GDP advances, starting not before November 9, 2009 and March 26, 1999 respectively, as before these dates no data is available on these figures.

As can be gathered from table 109, on page 164, which shows the futures' performances during the in-sample, except for the futures traded according to either PPI or durable goods orders, the performances are higher the higher the maturity of the futures. However, due to the higher duration and correspondingly higher volatility bonds with larger maturities have, on a risk-adjusted basis futures with shorter maturities are generally better off. More remarkable is that none of the portfolios outperforms the buy-and-hold strategy neither on a risk-non-adjusted nor on a risk-adjusted basis. Latter is perfectly shown by the negative excess Sharpe ratios. Furthermore, in contrast to the findings of researchers, who claim employment reports to be the most determining releases on bond yields and futures prices shortly after the publication, in this context, the risk-non-adjusted and risk-adjusted performance of the employment data-based futures is the best when compared with the other portfolios only for the thirty-days treasury future. The relative performance gets worse the higher the maturity of the future. For all other maturities, the futures traded on GDP advance announcements outperform, followed by those traded according to CPI data. Furthermore, for futures with these maturities, the performances are significant when traded either according to GDP advanced or CPI data. Table 110, on page 165, shows the portfolio results over the out-of-sample. Here, except for the GDP advance- and durable goods orders-based portfolios, which underperform the buy-and-hold strategy when based on the ten- and thirty-year t-note/bond futures respectively and accounting for risk, all other futures outperform the buy-and-hold strategy in both the long- and very long-term. CPI- and durable goods orders reports are the only ones whose information partially leads to outperform the passive long-only strategy also when based on short- and mid-term futures. These observations are valid when regarding risk-non-adjusted as well as risk-adjusted performances. In addition to the considerable inconsistencies of the portfolio performances when compared with the buy-and-hold strategy, the returns of all portfolios, without exception, are insignificant throughout. When compared with each other, the thirty-days, ten- and thirty-year futures perform the best when traded according to CPI data and the three-month, two- and five-year futures when traded according to durable goods orders information. Equal to what observed within the in-sample, also here are the risk-non-adjusted performances and volatilities the higher and the risk-adjusted

performances the lower the higher the future's maturity. As visible on table 111, page 166, during the short-term period ranging from February 10, 2000 to December 27, 2001, the patterns are rather similar to those of the in-sample, where the portfolios exhibit negative excess Sharpe ratios. The only difference is that in the long- and very long-term the futures based on GDP advance on the one hand and the futures based on durable goods orders and initial jobless claims on the other hand, manage to outperform the buy-and-hold strategy. Here, no clear patterns can be observed between the performance of the different announcement types-based futures. To some extent remarkable is only the relative good performance of the GDP advance-based futures. However, over this short period, the performances of the GDP advance-based futures are significant at the 90% level only for futures with maturities lower five years. Over the period between February 7 and March 3, 2003, whose results are listed on table 112, page 167, the thirty-days future outperforms the buy-and-hold strategy, except for when traded according to GDP advance figures, which performs similarly. Contrariwise, either the three-month, two-, five- or thirty-year future outperforms the buy-and-hold portfolio. During this period of less than one month, the reality checks are questionable as they amount to 1 and 0 for the thirty-days future and the remaining futures respectively. During the period extending from May 23 to October 17, 2003, with a few exceptions, the futures outperform the respective buy-and-hold strategy independently of the information they trade. Noticeable is the outperformance of all futures traded according to employment releases. Be it based on a short-, mid- or long-term bond future, employment data trading leads to a higher performance than trading any other economic growth or inflation information. However, here the returns are insignificant throughout. During the time frame between December 14, 2009 and January 3, 2011, whose results can be gathered from table 114, on page 169, the buy-and-hold strategy outperforms short-term futures like the thirty-days and three-months, independently of the information traded. However, for the two-, five-, ten- and thirty-year futures traded according to CPI data or initial jobless claims outperform the buy-and-hold strategy. Furthermore, when comparing the futures traded according to these two announcement types, the former leads to a higher performance independently of the future. Lastly, over the period extending from June 8 to November 14, 2011, visible on table 115, page 170, there are many inconsistencies with regard to the performance of the futures when compared to the buy-and-hold strategy, providing no clear picture at all. What is worth noting is just the performance of the futures traded according to CPI information. It is the only announcement type that leads to an equal or slightly higher Sharpe ratio than the buy-and-hold strategy for all futures. However, for mid- to long-term futures, returns are significant just at the 90% level.

Overall, it is visible that when trading according to macroeconomic variables, when not accounting for risk, one can profit the most from trading futures with larger rather than short maturities. This is also the case for a buy-and-hold strategy. However, as soon as the performance

is adjusted for risk, the opposite is observable. Then, trading shorter-term futures is more profitable. This is explainable through the higher duration bonds with larger maturities have. The higher the duration the more abruptly do futures prices change upon yield changes, consequently resulting in a higher volatility. It can be furtherly said that trading short-, mid- or long-term sovereign bond futures according to macroeconomic announcements may not necessarily lead to a higher risk-non-adjusted or risk-adjusted performance than when pursuing a buy-and-hold strategy. Table 116, on page 171, further shows the performance from those futures that result to outperform the buy-and-hold strategy on a gross return criterion, but now accounting for transaction costs. As among the two large periods, this was achieved only within the out-of-sample, only latter results are presented. As the results show, short-term futures with maturities up to three-months underperform the buy-and-hold strategy independently of the macroeconomic announcement they are traded upon as soon as costs amount to one basis point per trade. Things look somewhat differently when considering futures with larger maturities. As the out-of-sample results show, during that period trading the two-year t-note future based on durable goods orders or all announcements together would have been more profitable than pursuing a passive long-only strategy even when accounting for transaction costs of three basis points, whereas trading CPI information only when charged with two basis points per trade at most. Furthermore, trading the five-year future based on employment or initial jobless claims would have resulted in a positive excess Sharpe ratio after accounting for transaction costs of two and one basis point respectively, whereas when based on CPI, durable goods orders or all announcements together, the outperformance over the buy-and-hold strategy would still have been considerable even in case of transaction costs being three basis points. Even more remarkable is the risk-adjusted performance of the long-term futures. Independently of the information or the whether the ten- or thirty-year future is traded, the excess Sharpe ratios are positive even when charged with costs per trade of three basis points.

Despite the fact that actively trading long-term futures based on economic growth or inflation information result to be more profitable than a buy-and-hold strategy in the out-of-sample, on a whole, the portfolio performances are too inconsistent. Apart from being unprofitable within the in-sample, the significance tests show anything but sufficient evidence for the macroeconomic announcements to be responsible for the performances observed here. Latter enforces the assumption taken at the outset that by trading macroeconomic announcements with a one-day slippage the impact such announcements may have on bond futures prices may be missed. With regard to the announcement type, except for the period ranging from May 23 to October 17, 2003, where trading according to employment reports results in the highest risk-adjusted performance for all maturities, overall inflation indications based on the CPI are the most useful trading tool. Among the economic growth indicators in turn there is no clear winner, as their relative performances vary considerably depending on the period observed. It may be that such

macroeconomic announcements affect futures prices within the first hour after the announcement, allowing traders to profit therefrom. However, this cannot be verified using daily data. Nevertheless, what this study furtherly shows is that when looking at the price change between the closings of the day prior to the announcement and of the announcement day, it is observable that the judgement of the macroeconomic figures and the change in price do not coincide neither for short- nor for long-term futures. In other words, futures prices do not always increase (decrease) when macroeconomic variables deteriorate (improve). This is the case when each macroeconomic announcement is regarded in isolation as well as when regarded together. Even though reports on employment, CPI, durable goods orders and initial jobless claims are published on the same day, these can be interpreted equally for trading purposes. However, only in the rarest case can the very short-term effect of such announcements on futures prices be accounted for, as they provide only at times the same information. As table 117 shows on page 172, between December 31, 2015 and January 31, 2017, only on two announcement days did all reports provide the same information on economic growth and inflation. On both dates, their impact on futures prices was as expected. On the other hand, for GDP advance and PPI reports, which are applied on days where no other reports are published, short- and long-term futures prices do not always behave according to economic growth and inflation respectively. When trading US treasury futures based on all announcements at the same time, the risk-non-adjusted performance is considerably worse than that of the buy-and-hold strategy independently of the period and the future observed. However now, as the strategy considers to be out of the market whenever the announcements are contradictory on a given day, the volatility is far lower than that of the buy-and-hold strategy. This makes at least the Sharpe ratios of the futures with maturities higher two-years to be higher within the out-of-sample when traded according to economic growth and inflation announcements.

3.3.5. PCA Residuals Trading

As described in section 2.2.1, the aim of a PCA is to explain a dataset based on a few factors only. It reduces the dimensions of big datasets to a space of a few uncorrelated components, which are sufficient to explain the biggest part of the variance. In the world of fixed income trading, the application of a PCA to a dataset of bond yields covering the whole yield curve can be helpful, as it breaks the correlations between the factors underlying those, correspondingly allowing for a description of the dataset only with help of the three main uncorrelated components – level, slope and curvature. Especially important for the management of absolute return funds is that these components are not only uncorrelated to each other, but also to the market (Giannopoulos, Haworth, & Pelata, 2012, p. 11). Besides being useful for reducing the complexity of big datasets, PCA is helpful for the identification of mispricings among the observed bond yields relative to the implications of the PCA framework. The use of latter is helpful for

trading bond futures as it indicates when a sector of the yield curve is cheap or expensive (Baygün, Showers, & Cherpelis, 2000, p. 25), therefore allowing for betting on a possible convergence of that bond yield's development by going long or short the corresponding bond future. PCA makes that possible by allowing for a comparison between the real dataset and the dataset it reproduces. The difference between the observed correlations between bond yields and the correlations reproduced by the PCA is the residual/error. As shortly discussed in section 2.2.1, especially the residuals are used for trading market opportunities. The potential convergence of a bond yield is reflected by the development of the residuals, as these underlie mean reverting structures. A positive (negative) residual/error implies that the market value of the bond yield is higher (lower) than that implied by the PCA and therefore cheap (expensive). Residuals should be considered for trading only if they are significantly different from zero (Giannopoulos, Haworth, & Pelata, 2012, p. 3).

In this study, the PCA analysis is conducted on the level of US treasury bond yields with maturities ranging from one day to thirty years and run through SPSS. The difference between observed and reproduced correlations is always between the overnight bond yield and the bond yields of larger maturities. The factor analysis is first applied to the bond yields based on the level only, then on the level and the slope and lastly on the level, slope and curvature together. This distinction is highly noteworthy, as components not extracted in the analysis will be part of the residual. Therefore, at the outset, the residual is expected to be the highest when extracting only the component "level" and the lowest when extracting also the components "slope" and curvature". All three perspectives are regarded within an in-sample ranging between January 2, 2001 and January 7, 2003, as well as an out-of-sample extending from January 14, 2003 to January 1st, 2005. The PCA is always run on daily bond yield data of one year previous to the observation date. This is done in order to get highly significant PCA results. Trades are conducted only when residuals diverge steadily along a time-horizon of four weeks. As a positive (negative) residual indicates that the market value of the observed bond yield is cheap (expensive) relative to the implications of the PCA, a steady development away from zero may point towards a potential breakout and convergence to zero. Therefore, the trades are based on the assumption that bond yields may potentially go up (down) after getting cheaper (more expensive) week for week during an entire month. As a consequence, a long (short) position is held in the corresponding bond future only when along the previous four weeks the residual is negative (positive) and its size decreases (increases) throughout. Otherwise, no investment is done. Different to what is done in practice, the decision to trade is taken solely on the development and size of the residuals without taking into consideration any macroeconomic outlooks or views. On pages 83 to 86, a more illustrative explanation for the procedure followed in this analysis is provided. The results of the three analyses can be gathered from tables 118 to 120, on pages 173 to 175.

When trading PCA residuals based on the level of the yield curve only, it is observable that within both the in- and out-of-sample the futures manage only partially to outperform the buy-and-hold strategy under a gross return criterion. While PCA residuals trading results in a negative performance for the three-month t-bill and the two-year t-note futures over the in-sample, for the five-, ten- and thirty-year t-note/-bond futures the performance is rather positive. Over the out-of-sample, the opposite is the case, with exception of the ten-year t-note future, which performs positively also within the out-of-sample. When compared with the buy-and-hold strategy, the five- and ten-year t-note futures achieve a higher risk-adjusted performance over the first period, whereas the three-month t-bill and the two-year t-note future over the second period. In addition, only the returns of the five-year t-note future over both periods and the ten-year t-note future within the in-sample result to be highly significant. After transaction costs, the five- and ten-year t-note futures outperform the buy-and-hold strategy within the in-sample even when costs amount to three basis points per trade. On the other hand, within the out-of-sample, the three-month t-bill future exhibits a positive excess Sharpe ratio over the buy-and-hold strategy when charged with transaction costs of one basis point, whereas the two-year t-note future even when charged with three basis points per trade.

When the PCA is run on the first two components, therefore excluding the slope from the residual, the short-term futures with maturities of three months and two years exhibit a positive Sharpe ratio over both periods. The five- and ten-year t-note futures perform positively only within the in-sample. When compared with the buy-and-hold strategy, the two short-term futures achieve to outperform within the out-of-sample, while the five-year t-note future within the in-sample only. In contrast to what observed when trading the residuals from the PCA analysis based on the first component only, the returns are more significant throughout. While within the former, returns resulted to be highly insignificant for short-term futures with maturities of three months and two years, within the second they are either highly significant or insignificant, but latter to a much lower extent. Remarkable is that the performances are highly significant over those periods and for those futures that outperform the buy-and-hold strategy. This is a clear sign for the importance of the trading rule in inducing the performance. This is observable on table 119, page 174. Even when accounting for costs per trade of three basis points, short-term futures with maturities of three months and two years as well as the five-year t-note future outreach the buy-and-hold strategy over the respective periods.

The futures perform again differently when considering the residuals net of the first three components. Now, it is the two-, five- and ten-year t-note futures that exhibit a positive performance over both the in- and out-of-sample. On the other hand, the thirty-year t-bond future again exhibits a negative performance over both periods. Most noteworthy is that within this context no future achieves a positive excess Sharpe ratio over the buy-and-hold strategy.

When comparing the three methods with each other it is recognizable that short- to mid-term futures are more profitable when traded according to residuals based on the first two components, whereas long-term futures when traded according to residuals based on the first component only. Furthermore it is observable that independently of whether traded upon the first component only or the first two components, before transaction costs the buy-and-hold strategy is outperformed by the five-year t-note future within the in-sample and by both the three-month t-bill and the two-year t-note future within the out-of-sample. Therefrom, only the three-month future does not achieve to do so when accounting for costs per trade higher two basis points. Nonetheless, independently on how the residuals are computed, none of the futures achieves to outperform the buy-and-hold strategy over both the in- and out-of-sample.

4. Bond Portfolio Risk Management

Besides being useful for portfolio management, interest rate-based PCA results can be used to generate prospective yield curve scenarios. The scenarios can be helpful for the assessment of the portfolio's performance and risk (Giannopoulos, Haworth, & Pelata, 2012, p. 12). Different to when using PCA for portfolio management, where the residuals are of particular importance, for this purpose it is rather the loadings of the PCA components that are relevant. In the following, it is illustrated how possible yield curve scenarios could look like and how changes in the yield curve can affect the fixed income absolute return funds elaborated in this study.

4.1. Scenario Analysis

The aim of this section is to provide the reader with a risk assessment of the fixed income absolute return funds tested for in chapter 3, based on realistic yield curve scenarios. As most commonly done in practice, also here the risk of the portfolio is assessed following the ideas of Value at Risk (VaR). Similarly to Frye (1997) or Loretan (1997), the portfolio risk is gauged by applying a factor-based scenario method. The factor-based approach followed in this study differs from that of Frye (1997) or Loretan (1997) in that it consists in linearly combining only the first two principal components: level and slope. The third component – curvature – is disregarded as its existence is highly disputed by researchers. Overall, the application of a factor-based method is advantageous for the risk assessment of absolute return funds as it allows for assessing the risks specific to every single future included in the portfolio. It enables to come up with the response of the whole bond futures portfolio to changes in the yield curve level or slope by simply summing up the sensitivities of the futures included in the portfolio. In other words, assessing the fund's risk with use of a factor-based scenario method allows for identifying how sensitive the bond futures' portfolio as a whole may react to increases/decreases in interest rates and/or steeper/flatter yield curves underlying the portfolio components without any complex modelling approach (Frye, 1997, p. 3). The possible aggregation of sensitivities is

of particular importance here, as the portfolios include futures from different countries, being subject to different yield curves.

The PCA is run through the statistical software "SPSS" on 110 daily treasury yield changes from October 3, 2016 to March 3, 2017. On each of these days, the PCA is computed on one-year data prior to the observation date. The factor analysis is run for points from the very short to the very long end of the US and German yield curves. It is refrained from doing so for Australia and Japan. Equal to what applied so far, the points covered on the yield curves are the treasury rates with maturities of one day, three months, two, five, ten and thirty years. Moreover, the PCAs are computed for the US and German yield curves separately and not in conjunction. Even though it would be possible to draw some conclusions from the co-movement of yield changes across countries by running the PCA on both yield curves simultaneously, the level and slope are not expected to have the same explanatory power as they have when applied on one market only. According to Phoa (2000), who analysed the co-movement of bond yields across the US, German, Australian and Japanese treasury markets over three different datasets falling between 1970 and 1998, a factor shifting each country's yield curve in the same direction and magnitude is visible (p. 169). However, this parallel shift explains the variance in bond yield changes to a much lower extent. While in the 1970s the parallel shift did not explain more than 29% of global bond yield changes, in the 1990s it did not more than 54%. Furthermore, even though a parallel shift may be visible across countries, it is not of global reach, as not all countries' bond yields move when the bond yields of other countries do. Phoa (2000) finds evidence for that being true for Australia in the 1970s and 1980s (pp. 170-171).

Over the last decades the US and German yield curves have overall been positively sloped and their levels have been decreasing. This development may last for the upcoming years, but it must not necessary. Besides interest rates keep decreasing and the yield curve remaining positively sloped, other scenarios are also imaginable. This study accounts for twelve yield curve scenarios other than what experienced in recent years. The yield curves are simulated by applying shocks to the first principal component, the second or both:

Scenario 1: *Negative shock on factor level*

Scenario 2: *Positive shock on factor level*

Scenario 3: *Highly positive shock on factor level*

Scenario 4: *Negative shock on factor slope*

Scenario 5: *Positive shock on factor slope*

Scenario 6: *Highly positive shock on factor slope*

Scenario 7: *Negative shock on factor level and positive shock on factor slope*

Scenario 8: Positive shock on factor level and positive shock on factor slope

Scenario 9: Highly positive shock on factor level and highly positive shock on factor slope

Scenario 10: Negative shock on factor level and negative shock on factor slope

Scenario 11: Positive shock on factor level and negative shock on factor slope

Scenario 12: Highly positive shock on factor level and highly negative shock on factor slope

The measures resulting from the PCA relevant for the factor-based scenario analysis are the loadings and the scores of the first two components. How these are computed is explained in section 7,6., to be found in the appendix. The application of the factor-based scenario method is analogous to Frye (1997). The shock for a particular treasury rate is the product of the PC standard deviation, the interest rate specific PC loading and the quantile's z-value. Latter is used for steering the severity of the shift or flattening of the yield curve, as the factor-based scenario method relies on the quantiles of a standard normal distribution (Frye, 1997, p. 5). Depending on the intensity of the yield curve's shift or twist, lower or higher quantiles are considered. Similarly to Loretan (1997), who applied a wide range of quantiles extending from 1% to 99,5% for different scenarios, this study considers the quantiles of 51%, 75%, 95%, 99%, 99,9%, 99,997% as well as $99,\overline{99}\%$. While the former two are applied to scenarios 1, 2, 4, 5, 7, 8, 10 and 11, the remaining quantiles are applied to scenarios 3, 6, 9 and 12. Different to Loretan (1997), who uses quantiles below (above) 50% for negative (positive) shocks, in this study the direction of the shock is steered by changing the sign to (-) or (+). This is the reason why quantiles below 51% are not considered. Nonetheless, the sign of the shocks is dependent on the direction of the yield curve factors on every interest rate. For instance, as it is visible on table 121, page 176, for the US yield curve the first component causes all points on the yield curve to rise, while the second component causes the whole yield curve to flatten by increasing the short-term interest rates with maturities of one day and three months and decreasing longer-term treasury rates. On the other hand, as recognizable on table 128, page 182, the factors steer the German yield curve points in different directions, as the component loadings vary considerably among the different points on the yield curve. While the first component influences the one-day treasury rate negatively and treasury rates with longer-term maturities positively, the second component influences the three-months rate negatively, whereas longer-term rates positively.

Table 123, on page 178 shows the changes in bps for the six points of the US yield curve under each scenario. As the first component loading is positive for all interest rates, it is not surprising that under scenario 1 all yield changes are negative. What is remarkable however, is that the yield changes are higher among long-term than short-term yields. The reason for the higher influence a downwards shift has on long-term treasury rates is the higher influence the first component has on them. This is represented by the higher loadings. The same relation applies

for scenarios 2 and 3 with the only difference that within these scenarios the yield changes are rather positive. Noteworthy is also the small the yield changes are even under scenario 3, which implies a significant increase in the factor level. Even when applying a shock of six standard deviations (quantile of 99,$\overline{99}$%) does the yield change amount at most to 11,93 basis points. The reason for the yield changes being so low even for shocks of up to 6 standard deviations is the low standard deviation of the first component over the period between October 3, 2016 and March 3, 2017. As visible on table 127, on page 182, the yield of the ten-year t-note, which is affected the highest, changes only by 1,988 bps by the factor level. Figure 10, on page 182, shows the simulated yield curves of scenarios 1 and 2 based on shocks of 0,67 standard deviations and of scenario 3 with a shock of 4 standard deviations. Under scenarios 4, 5 and 6, the biggest changes occur among the short-term maturities of one day and three months. Here, while a negative shock on the factor slope causes the slope of the yield curve to steepen even further, the opposite is the case for a positive shock. Other as for the factor level, which is the highest among rates with maturities higher two years, the factor slope is the highest for the very short-end of the yield curve. This is illustrated by the high (low) loadings of the factor slope on the very short-term (long-term) yields, visible on table 127. However, even when applying a shock of 4 or even 6 standard deviations, the yield curve remains overall positively sloped, with a stronger inversion between the three-month and two-year rates. How the yield curve moves upon a shock of 4 standard deviations is shown on figure 11, on page 183. When looking at the simulated yield changes of scenario 7, it is not surprising that the short-term rates with maturities of one day and three months increase, while the rates with larger maturities decrease, the higher the shock applied. This has several reasons. The first reason is the highly positive (slightly negative) effect the slope factor has on very short-term (longer-term) rates. Second, while the factor level determines changes in yields of larger maturities to a greater extent than the factor slope does, the opposite is the case for yields with maturities of one day or three months. Furthermore, the difference in yield changes between the two factors is by far larger for short- than long-term yields. While the factor slope changes the one-day and the three-month's yield by 12, 83 and 10,23 basis points respectively, the factor level does it only by 0,25 and 0,43 basis points respectively. Among the remaining points on the yield curve, the difference is the highest for the thirty-year t-bond rate, where the factor level and the factor slope change the yield by 1,84 and -1,54 basis points respectively. Under scenario 8, where the level is positively shocked, short-term rates increase to a slightly higher extent than under scenario 7, while the rates with maturities larger than two years now increase. Again, the reason for these rates to increase under scenario 8 and not under scenario 7, is that under scenario 8 the shocks on the level and the slope are not applied in the same, but rather in the opposite direction. Furthermore, for these yields the factor level explains a higher part of the change than the factor slope does. The higher impact the slope factor has on the rates with maturities of one day and three months is the clear-

er the more extreme the scenario is. Under scenario 9, consisting in a significant shock in the first two principal components, a shock of 3,09, 4 or even 6 standard deviations causes the one-day and three-month yields to rise by 40 and 32, 52 and 42, as well as 78 and 63 basis points respectively, whereas longer-term yields rise at most by 8 basis points. Under scenario 10, all treasury rates decrease with the considerably higher change in the short-end of the yield curve, whereas under scenarios 11 and 12, only the rates with maturities of one day and three months decrease. As scenarios 11 and 12 perfectly reflect, the more positive (negative) the shock on the factor level (slope), the steeper gets the yield curve. As it is clearly visible on figures 10 to 13, on pages 182 and 183, under scenarios 1 to 3, the biggest yield changes come along on the very long-end of the yield curve, under scenarios 4 to 11 on the very short-end of the yield curve, whereas under scenario 12 on both short- and long-term yields.

Table 125, on page 180, shows the changes in bps for the six points of the German yield curve under the twelve scenarios. On the other hand, table 128, on page 182, shows the components' standard deviations and loadings for all examined German yield curve points. As observable on latter, except for the overnight rate, loadings of the factor level are as for the US yield curve positive. Therefore, while under scenario 1 a shock leads to a decrease in all interest rates other than overnight, under scenarios 2 and 3 the opposite is the case. As for the US yield curve, yield changes are higher among rates with maturities larger two years. Also here, the higher changes are attributable to the higher determining power of factor level in these rates. The loadings are by far greater for treasury rates with maturities of two years or longer than for the one-day treasury rate. In contrast to what observed for the US yield curve, German treasury rates are far more volatile. For instance, while under scenario 1 US treasury rates decrease at most by 1,34 basis points, German government bond rates decrease the least by 1,89 and the most by 8,86 basis points. This obviously induces a higher impact on the overall level of the yield curve. As observable on table 128, the higher changes in rates for the German yield curve are not a result from higher loadings, but rather from higher volatilities. While since October 3, 2016, the PC1 score of the US yield curve varied just by 2 basis points, that of the German yield curve did it by 13,8 basis points. Figure 15, on page 184 shows the simulated yield curves of scenarios 4 to 6, again based on shocks of 0,67 and 4 standard deviations. Equal to what observed for the US yield curve, the biggest changes occur among the short-term rates with maturities of one day and three months. While the former is positively affected by the factor slope, the second is negatively. All other rates are positively impacted too. As it is visible on table 128, the loading of PC2 is by far larger for points on the short-end of the yield curve as for mid- to long-term rates. Furthermore, the standard deviation of PC2 is very high when compared with that of the level, amounting to 100 basis points. Latter is mainly induced by the volatility of PC2 for the three-month and the overnight rate. Figure 16 perfectly illustrates how variable German short-term rates have been during the last half year. It further shows how a negative (positive) impact

on the overall slope of the yield curve leads latter to be positively sloped (inverted) in the very short-end. Under scenario 7, the yield curve inverts in the very short-end, remains inverted from three-months to two years and shifts downwards overall. The inversion in the very short-end of the curve is explainable by the high determining power of the slope on the very short-end of the yield curve. As visible on table 128, the overnight and three-month rate increase and decrease by 82 and 58 basis points respectively, when a one standard deviation shock is applied. Under scenario 8, besides a higher level, the slope between the three-month and two-year rates gets positive. Under scenario 9 the yield curve gets highly inverted in the very short-end, highly positively sloped between the three-month and two-year rates and its level increases obviously to a higher extent than under scenario 8. For shocks higher than 1,64 standard deviations the five-year rate gets even positive. Finally, under scenarios 10 to 12, the yield curve is also affected the most on its short-end, but in contrast to what observed under scenarios 4 to 9, the yield curve is highly positively sloped in the very short-end and highly inverted between the three-month and two-year rates. A negative/positive shock on the factor level and a negative shock on the factor slope lead all short- to mid-term rates, with exception of the three-month, to remain negative.

4.2. Portfolio Impact

Once possible yield curve scenarios are built, it begs the question how they might impact the constructed fixed income absolute return funds. The scenarios alone do not provide any information on how a portfolio's value may react to changes in the US and German yield curves. Therefore, in a next step it is elaborated on how sensitive absolute return funds may be to the scenarios treated before. The sensitivities of the absolute return funds are compared to those of a passive long-only strategy, again represented by the B&H portfolio. This is done with the aim of identifying differences in risk between long/short and long-only portfolios. For simplicity, the absolute return fund is proxied by the TSC and 2. CSC portfolios. The reason for considering the carry portfolios in a time-serial and cross-sectional context is the different weightings they apply. Furthermore, these two portfolios resulted to outperform the B&H portfolio over decreasing and increasing interest rate periods respectively. As known, while the former weighs each portfolio component equally, the second does rather levered investments in a few futures. As interest rate risk measure, the modified duration is used. Latter is computed according to Baz et al. (2015). This study focuses on the risk of absolute return funds over a very short time-period. As in all other analyses conducted in this study, it is accounted for a one-day lag between allocation decision and trading. This represents at the same time the minimum time that the fund manager would have to react on a change in the yield curve.

Table 129, on page 185, shows the sensitivities of the TSC, 2. CSC and B&H portfolio for all scenarios and all quantiles on the last day of the study's sample, which falls on March 3, 2017.

Therefrom it can be gathered that under those scenarios having a negative impact on US and European futures, the downside risk encountered through the TSC portfolio is lower than through the B&H equivalent. The potential loss is considerably lower for the long/short portfolio than for the long-only portfolio. This is the case for all scenarios other than scenarios 1, 4, 7 and 10. Under latter, both portfolios react positively, with somewhat higher gains for the B&H portfolio. It is further observable that for both portfolios the highest gain results under scenario 10, when both factors are subject to a negative shock, whereas the highest loss results in case of a highly positive shock on both factors, represented by scenario 9. While pursuing a time-serial carry long/short portfolio effectively leads to a lower risk under any scenario, the same is not applicable to the 2. CSC portfolio. Even though, on a whole the 2. CSC portfolio is less sensitive to yield curve changes than the long-only strategy is, it is not the case throughout. While under scenarios 2, 3, 8, 9, 11 and 12 the 2. CSC portfolio reacts less negative (more positive) than the B&H portfolio, under scenarios 5, 6 and 7 its value is eroded to a greater extent. Similar to the TSC portfolio, the 2. CSC portfolio underperforms the B&H portfolio whenever latter reacts positively to yield curve changes. In contrast to the TSC portfolio, the cross-sectional carry strategy experiences the highest value gain under scenario 12, which implies a highly positive (negative) shock on factor level (slope). The highest loss however, occurs under scenario 9 too.

On a whole, long/short strategies seem to be less sensitive to changes in the yield curve than a passive long-only strategy does. Even though long/short portfolios may profit to a somewhat lower extent from favourable yield curve changes, they encounter a lower downside risk than for a long-only portfolio. This analysis further shows that for both long/short strategies and the long-only strategy, the worst scenario results to be when the factors level and slope are positively shocked.

5. Conclusion

This study has provided further evidence on the effectiveness of fixed-income long/short strategies based on the investment styles carry, value and/or momentum, on the usefulness of a set of selected market implied information sources, macroeconomic variables and statistical results as potential trading tools, as well as on the use of a factor-based scenario method for the quantification of portfolio risks. The former strategies have been previously examined by researchers such as Moskowitz, Ooi and Pedersen (2011), Koijen et al. (2012), Asness, Moskowitz and Pedersen (2013) or Baz et al. (2015). While the former three have elaborated on the performance of momentum in a time-serial context, carry within both a time-serial and cross-sectional setting as well as value and momentum in a cross-sectional framework respectively, latter have rather investigated all three investment styles within both settings and when applied in isolation or together. This study has followed a similar approach as Baz et al. (2015), as it examined the

performance of all investment styles within both settings and on portfolios based on liquid sovereign bond futures of different currencies and maturities. However, it differs from it in that it considers not only one, but two different methods to compute a cross-sectional carry trade portfolio. Therefore, this study principally combines the works of Koijen et al. (2012) and Baz et al. (2015). This study further extends the perspectives of recent research, in that it tests the long/short portfolios not only under a decreasing, but also under an increasing interest rate environment. Furthermore, it compares the long/short portfolios with a passive long-only strategy on a gross and a net return basis, it examines the portfolios not only over large, but also over short time-periods and lastly, it regards the performance of the carry trade portfolios by also accounting for the carry return. Overall, the purpose of the analysis on investment styles was primarily to figure out how these long/short strategies behave under different yield curve environments, such as changes in the level, slope or curvature, when compared with a passive long-only strategy.

The results of this study reveal that the performance of investment styles and the two weighting schemes may be dependent on the interest rate environment. On the one hand, the investment styles carry and value are found to perform positively and even outperform the buy-and-hold portfolio over decreasing interest rate periods when traded in a time-serial context and under a gross return criterion. The outperformance is given independently of whether applied alone or together. On the other hand, only the 2. CSC portfolio achieves to do so over both large and partially over short increasing interest rate periods. It is observable that independently of whether observed over a short- or long-term period, if at all, except for the 1. CSC portfolio, only cross-sectional portfolios are likely to break correlations to a level near to zero. However, this is rather unsurprising as the cross-sectional portfolios unlike the 1. CSC portfolio consist in being exposed to a few futures only at a time. Besides performances of cross-sectional portfolios being higher over increasing interest rate periods, the lower correlations among their portfolio components lower the whole portfolios' volatilities, consequently leading to higher risk-adjusted performances. From the results underlying the analysis on long/short strategies, it may be concluded that directional strategies based on carry, value or a combination therefrom may be the best option under a decreasing interest rate environment, whereas cross-asset weighted carry portfolios, consisting in trading only bond futures with the highest positive and highest negative trading signals, under an increasing interest rate environment. On the other hand, despite finding evidence for the higher performance of some long/short strategies under different interest rate environments, the portfolio components' returns are overall insignificant, lowering the meaningfulness of the investment styles' trading signals in being responsible for the outperformances. Accounting for carry returns when regarding the long/short portfolio performances, allows for identifying that the portfolio with the highest carry gain is not necessarily the one with the highest overall performance. This reflects the importance of returns arising from

changes in the level besides the importance of returns arising from changes in the slope and/or curvature of the yield curve. Positive (negative) returns arising from decreasing (increasing) interest rates may have a higher positive (negative) effect on a bond future's performance than the carry return does, consequently improving (deteriorating) the overall performance. Accounting for the carry return further allows for identifying that long/short carry trade portfolios may not gain a carry higher than that of a long-only portfolio throughout. Carry-based long/short strategies are also found to gain equally high or even somewhat lower carries than a B&H portfolio in case of latter performing positively. A possible explanation for such differences may lie in that passive long-only strategies may be able to gain positive and similarly high carry returns than long/short strategies as long as the yield curves underlying the portfolio components are overall positively sloped. However, the more inversions the yield curve is prone to, the more effective might be a long/short strategy, as latter can profit not only from positive carries by going long, but also from negative ones by going short. Among the carry trade portfolios, only the 2. CSC portfolio is found to gain a positive carry independently of the time horizon and interest rate environment. Its high carry returns when compared with the B&H portfolio may be explainable for its overall outperformance over increasing interest rate periods. After examining the usefulness of the different investment styles when applied alone, it has been also accounted for their performance when applied together within a directional setting. Among the time-serial combined portfolios, the portfolio based on TSC and TSV is found to outperform all other portfolio combinations, including the passive long-only portfolio, over decreasing and increasing interest rate periods. While this study founds promising evidence for the conduct of long/short strategy portfolios before transaction costs for both interest rate environments, when accounting for transaction costs, only the TSV portfolio is found to still outperform the B&H portfolio over decreasing interest rate periods when accounting for costs per trade of one basis point. The TSV portfolio achieves to do so as different to the TSC it is based on fewer rebalancing decisions. The areas of investment styles combinations and portfolio rebalancing provide room for further research. First, complementary to the investigation on time-serial portfolios based on several investment styles, further research shall be conducted on the interaction of such when traded in a cross-asset setting. Moreover, there is room for lowering the rebalancing frequency of cross-sectional long/short portfolios. It would be worth testing for long/short portfolios based on fewer reallocation decisions and therefore less prone to transaction costs.

This study has further consisted in examining macroeconomic and statistical information for the further optimization of fixed income absolute return fund management. More precisely, it has tested information on future shifts in the federal funds rate, inflation expectations implied in TIPS and inflation swaps, cash rate decisions and QE actions on behalf of the most important central banks like the Fed, ECB, BOJ, RBA and BOE, interest rate-based PCA results as well as US announcements on economic growth and inflation. Against expectations, the price of the

federal funds future is not found to be a reliable estimator of future interest rate changes on behalf of the Fed. When not adjusted after every interest rate decision, the federal funds future price implies unreliably high rates and probabilities of future changes. If adjusted, the implied rate behaves rather stable, consequently providing any signals on future changes. While before the adjustment, the funds future at least provides some correct signals, when adjusted it does not. The inflation expectations have been tested within a portfolio context, by being traded through 10/50 SMAs, LMAs and EMAs. Despite some differences in performance between the moving average types, on a whole, actively trading inflation expectations implied in TIPS and inflation swaps induces a higher performance than a passive long-only strategy only in the rarest case. As soon as costs of one basis point per trade are charged, even those futures that resulted to outperform the passive long-only investments, newly underperform it. Besides being worse, returns result to be highly insignificant too. Possible explanations for the uselessness of inflation expectations as trading information might be that such are not real, but rather expectations only, and that the break-even and inflation swap rates may comprise considerable liquidity and inflation risk premia, which in turn leads them to reflect less changes in inflation expectations, but rather changes in liquidity and uncertainty about future inflation. However, it shall be noted that whether inflation expectations implied in these underlying rates are effectively altered by liquidity and inflation risk premia, is highly disputed among researchers. Moreover, while the effectiveness of cash rate decisions on behalf of central banks have been examined within a portfolio framework, announcements on QE actions have been analysed out of a portfolio context. On a whole, it can be observed that trading treasury futures upon cash rate decisions is as expected the more profitable the shorter the maturity of the traded future, due to the higher impact such decisions may have on them. For the US, EU and Australia, over a large period, only trading the three-month t-bill future results to be more profitable than a passive long-only strategy in the same future, whereas for Japan and the United Kingdom not even the three-month does. It shall be furtherly noted that the Euribor three-month future is profitable when trading changes in the deposit facility rate, but not when based on changes in the MRO. The performances of all US futures are found to be significant over a large period. Furthermore, among them, the significance of returns is also found be the higher the shorter the maturity of the traded future. These observations can be made independently of whether interest rate decisions are traded on the day of announcement or on the day of implementation. The only important difference between the two perspectives is that over larger periods, one can profit from a somewhat higher return when trading on the day when first announced to the public. The outperformance of the US three-month t-bill future over the passive long-only strategy is also given when accounting for costs per trade of one basis point. For the Euribor and Australian three-month futures, this is the case even when charged with costs per trade of up to three basis points. Observations are more inconsistent when analyzing the effect of QE announcements on treasury rates and credit risk on

the day of an announcement as well as between announcements. Remarkable may be the immediate effect of new FOMC liquidity enhancing actions on the US ten-year t-note rate up to September 2012 and between announcements before September 2011, the impact of BOJ decisions on QE after almost every press release or the impact of decisions on behalf of the BOE on the gilt rate from June 2010 on. Up to the third quarter of 2011 inclusive, evidence has also been found on the possible impact of QE decisions on behalf of the FOMC on German bond yields. Consistent with research, corporate credit spreads and long-term treasury rates were found to correlate negatively for all markets when analyzed over the whole period. Otherwise, no consistent interrelation could be observed between QE announcements, interest rates and credit risk. Similar to what observed when trading treasury futures according to cash rate decisions, on a risk-adjusted basis, trading short-term futures according to information on economic activity and inflation is more profitable than trading long-term futures based on the same. However, evidence has been found for even short-term futures not being able to outperform a passive long-only strategy throughout. Overall, futures performances are found to be too inconsistent and not statistically significant. Among announcement types, inflation from CPI reports results to be the most useful information for trading inflation changes, whereas among economic activity indicators no clear differentiation can be made. While findings on trading economic growth and inflation variables in isolation are not favorable when compared with a passive long-only strategy, findings on trading all variables at the same are it either. Lastly, also interest rate-based PCA residuals have been tested as a complementary trading tool. These have been computed by first extracting the first principal component (PC) only, second the first two PCs and third the first three PCs. Among the three methods, short- to mid-term futures are found to be more profitable when traded according to residuals based on the components level and slope, whereas long-term futures when traded according to residuals based on the level only. However, when compared with a passive long-only strategy, none of them achieves to outperform overall periods.

After testing several investment styles and further information sources for the management of the absolute return funds, this study has also assessed the potential risks such can encounter. It has done so by accounting for the portfolio components' sensitivities under twelve different scenarios, all subject to shocks of different directions and sizes to the components level and slope of the US and German yield curves. This study has found the value of long/short strategy portfolios to be less sensitive than a passive long-only strategy to abrupt changes in the yield curves. While long/short portfolios are limited in profiting from changes favouring the underlying futures, potential losses can be reduced considerably. Among the many interest rate scenarios tested for, positive shocks on the components level and slope are found to have the highest negative impact on the two absolute return funds tested.

6. Bibliography

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7. Appendix

7.1. Procedure of PCA Residuals Trading

As this study examines the effectiveness of residuals trading for the whole yield curve, by taking into consideration rates with maturities of one day, three months, two, five, ten and thirty years, in total six time-series are subject to the PCA. Let y_{t0}^{n}be the today's yield of a bond, where n takes up the maturities of either one day, three months, two, five, ten or thirty years. The correlations and residuals are reproduced week for week based on the yield level of the previous 360 days. For instance, the bond yields from January 3, 2000 to January 2, 2001 are subject to the analysis of January 2, 2001. Taking the US overnight yield as an example, the time-series looks as follows:

$$y_{t0,k}^{1\,day} = \begin{bmatrix} y_{t0-360}^{1\,day} \\ y_{t0-359}^{1\,day} \\ \dots \\ y_{t0-1}^{1\,day} \\ y_{t0}^{1\,day} \end{bmatrix}$$

Every time-series is then subject to the PCA, which is run extracting the number of components desired for the description of the dataset's variance. In this specific case, this is done first for the first component alone, second for the first two components and third for the first three components. While the level explains about 65 to 85% of the dataset's variance, the slope and the curvature explain about 20 to 35% and 1 to 5% respectively. In the following, SPSS outputs for the computations done on January 2, 2001 and January 7, 2003 are presented. These aim to show how the explanatory power of level, slope and curvature are likely to vary through time:

Table 1: PCA Residuals Trading: Total Variance Explained Output - 03.01.2000-02.01.2001 (Bloomberg L.P., 2017, own output from SPSS)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,364	72,727	72,727	4,364	72,727	72,727
2	1,225	20,418	93,146			
3	,249	4,144	97,290			
4	,151	2,514	99,804			
5	,009	,157	99,961			
6	,002	,039	100,000			

Extraction Method: Principal Component Analysis.

Table 2: PCA Residuals Trading: Total Variance Explained Output - 08.01.2002-07.01.2003 (Bloomberg L.P., 2017, own output from SPSS)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,865	81,082	81,082	4,865	81,082	81,082
2	,970	16,161	97,243			
3	,108	1,806	99,049			
4	,050	,828	99,878			
5	,007	,110	99,988			
6	,001	,012	100,000			

Extraction Method: Principal Component Analysis.

Even more important for the purpose of this analysis are the residuals, which represent the difference between the observed correlations in the original dataset and the correlations reconstructed by the PCA (Giannopoulos, Haworth, & Pelata, 2012, p. 11):

$$residual_{t,k}^{n} = original\ data_{k}^{n} - reconstructed\ data_{k}^{n} \tag{30}$$

where t stands for the date when the observation was made, $k$for the number of days during which yield rates were collected and n for the maturity of the yield. As in total six bond yields were regarded and the PCA was always conducted based on one year yield rates, k equals 360 and n equals 6. As it is visible on table 3, the PCA is run for the six bond yields. However, the only residuals that are considered here are those representing the difference in correlations between the yield of the US overnight treasury and treasuries of larger maturities.

Table 3: PCA Residuals Trading: Example of Reproduced Correlations & Residuals (Bloomberg L.P., 2017, own output from SPSS)

Reproduced Correlations

		US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
Reproduced Correlation	US_Overnight	,386[a]	,535	,608	,602	,600	,592
	US_3_months	,535	,742[a]	,843	,835	,832	,821
	US_2_years	,608	,843	,957[a]	,948	,945	,932
	US_5_years	,602	,835	,948	,940[a]	,936	,923
	US_10_years	,600	,832	,945	,936	,933[a]	,920
	US_30_years	,592	,821	,932	,923	,920	,907[a]
Residual[b]	US_Overnight		,285	-,128	-,169	-,179	-,174
	US_3_months	,285		-,065	-,110	-,123	-,116
	US_2_years	-,128	-,065		,042	,036	,018
	US_5_years	-,169	-,110	,042		,060	,044
	US_10_years	-,179	-,123	,036	,060		,062
	US_30_years	-,174	-,116	,018	,044	,062	

Extraction Method: Principal Component Analysis.

a. Reproduced communalities

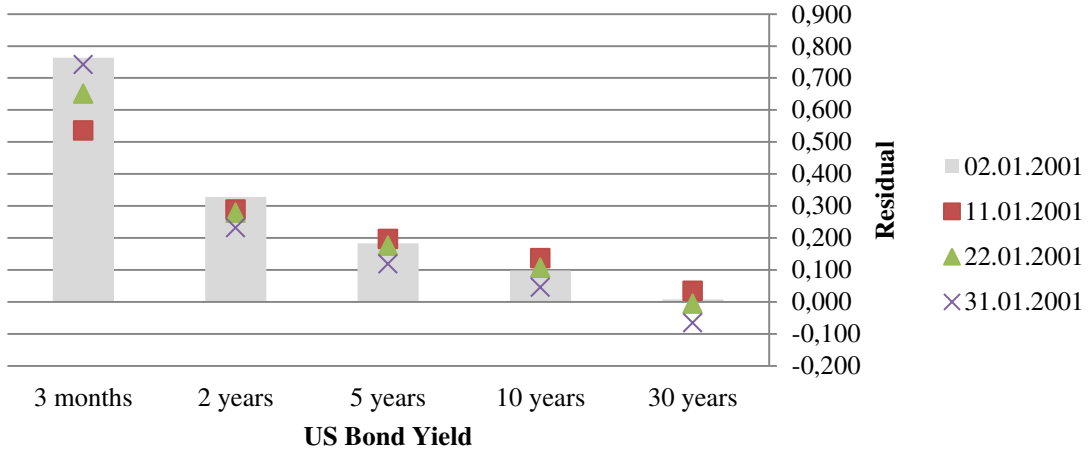
b. Residuals are computed between observed and reproduced correlations. There are 11 (73,0%) nonredundant residuals with absolute values greater than 0.05.

Now, consider the residuals to be the following in January 2001:

Table 4: PCA Residuals Trading: Example of Residuals in January 2001 (Bloomberg L.P., 2017, own graph)

US Overnight	02.01.2001	11.01.2001	22.01.2001	31.01.2001
US_3_months	0,763	0,536	0,651	0,742
US_2_years	0,328	0,288	0,279	0,231
US_5_years	0,183	0,196	0,175	0,118
US_10_years	0,098	0,137	0,106	0,045
US_30_years	0,008	0,034	-0,006	-0,065

Figure 1: PCA Residuals Trading: Example of Residuals in January 2001 (Bloomberg L.P., 2017, own graph)



The corresponding futures are traded according to the size and development of the residuals over the four weeks prior to the observation date. According to the trading rules described in section 3.3.5, none of the futures would have been traded here, as for none of the yields the residuals are both of equal sign and of increasing or decreasing size throughout. Would the size

of the three-month t-bill yield residual have been positive, but below 0,536 on January 2, 2001, a short investment would have been made in the three-month t-bill future, as then the t-bill yield would have been perceived to be cheap and therefore be likely to increase in near future.

7.2. White Reality Check

In this work, the parameter stability test applied to the portfolio performances is a bootstrapping methodology called White reality check. The idea behind this tool is to test to what extent the returns arise due to the use of trading signals and to which other extent they might be just a result of luck. According to Aronson (2007), the "White Reality Check" bootstrap methodology consists of four main steps and is subject to some conditions (pp. 239-241):

1. **Detrending:** The original/initial sample has to consist of the returns earned by the trading rules on data, whose trend has already been excluded beforehand. This data has an average return of 0.
2. **Zero-centering:** This terminology stands for the adjustment of the returns, making the return gained by the rule equal to zero, if not already the case. This needs to be done in order to have returns consistent with the null hypothesis (H0). Latter states that the average return needs to equal 0 and that therefore trading rules do not have any predictive power. The procedure of zero-centering consists in the subtraction of the mean return, which is calculated beforehand, from each single rule return.
3. **Resampling:** One condition of the bootstrapping methodology is that the number of observations used in the resamples always equals the number of observations used initially (raw data). The resamples are done by sampling with replacement. Latter means that after a return is randomly picked and recorded, that specific return is put back into the sample. Only by proceeding this way, the variability in the sample statistic can be achieved.
4. **Averaging:** Finally, one needs to take the mean from each resample. This results in a number of means equal to the number of observations of one sample. With these means, the sampling distribution can then be constructed.

Once the new sampling distribution is constructed, it can be evaluated whether the returns occur just due to chance (H0) or whether they are the result of the trading rule's predictive power (H1). Please note that within this context the null and true hypotheses have another meaning. These are judged by calculating the p-value and then comparing this p-value with the alpha level. Within White's reality check, the p-value can be computed as the ratio between those sample means equal to or higher than the original sample mean and the total number of resample means. Usually, the confidence level on which the hypothesis is tested amounts to

95%, resulting in an alpha level of 5%. From a trader's perspective, the check is realized with the aim of accepting the true hypothesis (H1). This is the case, when the p-value does not exceed the alpha level. In other words, if the hypothesis is tested on a confidence level of 95%, then the true hypothesis can be accepted only if the p-value is equal to or lower than 5%. Otherwise, the trading rule has no or just partial predictive power and consequently the null-hypothesis cannot be rejected (Aronson, 2007, pp. 441-444).

In this work, the reality checks are applied to the futures' return series before transaction costs. The reality check is based on 1'000 resamples and computed through VBA. For simplicity, in the following it is illustrated how the check can be applied in excel using 100 resamples. For illustration, the null-hypothesis is tested at a confidence level of 95% and an alpha level of 5%:

1. **Detrending:** establish a vector consisting of the detrended daily gross Profits and Losses (P&L) of the future prone to the trading rule.

$$Vector\ 1 = \begin{Bmatrix} daily\ gross\ return_{t0} \\ \dots \\ daily\ gross\ return_{N-1} \\ daily\ gross\ return_{N} \end{Bmatrix}$$

2. **Zero-centering:** create a new vector (2) by subtracting the mean return of vector 1 from each daily return

$$Vector\ 2 = \begin{Bmatrix} daily\ gross\ return_{t0} - mean\ return_{t0-N} \\ \dots \\ daily\ gross\ return_{N-1} - mean\ return_{t0-N} \\ daily\ gross\ return_{N} - \ mean\ return_{t0-N} \end{Bmatrix}$$

3. **Resampling:** conduct the first resample (vector 3) by randomly picking with replacement a value of vector 2 and continue doing so until you have a resample consisting of N-values. The resample is useful only when the number of randomized values equals the number of the original sample's values. In excel, the random gross daily returns (x_i) can be generated by using the following formula:

x_i=INDEX(\$**vector 2**\$$\boldsymbol{t0}$:\$**vector 2**\$**N**;ROWS(\$**vector 2**\$$\boldsymbol{t0}$:\$**vector 2**\$**N**)*RAND()+1)

$$Vector\ 3 = \begin{Bmatrix} \mathrm{x}_0 \\ \dots \\ \mathrm{x}_{N-1} \\ \mathrm{x}_N \end{Bmatrix}$$

Repeat step 3 until you get in total 100 vectors (vectors 3 to 103) of randomized gross daily returns.

4. **Averaging:** Take the average of each resampled vector created in step 3, resulting in 100 mean-returns. Distribute the mean returns and figure out what proportion (p-value) of resampled mean-returns is equal high or even higher than the mean return of the original sample used in step 2.

$$p-value = for\ k_3^{103}\ \frac{\text{count only if(mean return}_{vector\ k} \geq \text{mean return}_{vector\ 1})}{\text{number of vectors}_{k_3^{103}}}$$

5. **Evaluation:**

$$reject\ H0\ if\ p-value \leq alpha\ level$$
$$reject\ H1\ if\ p-value > alpha\ level$$

7.3. Increasing Interest Rate Periods

Table 5: Periods of sharply rising 10-year US Treasury Rate - 1998-2013
(based on Niederhoffer, R., & Weddepohl, C., 2014, p. 12)

Start Date	End Date
January 5, 1999	January 31, 2000
November 8, 2001	March 14, 2002
June 16, 2003	September 2, 2003
March 17, 2004	June 14, 2004
June 28, 2005	November 4, 2005
June 1st, 2005	June 30, 2006
March 18, 2008	June 13, 2008
September 18, 2008	October 17, 2008
December 1st, 2008	April 30, 2010
January 16, 2009	June 8, 2009
December 1st, 2009	April 5, 2010
November 5, 2010	March 3, 2011
July 2, 2012	November 29, 2013
May 3, 2013	September 5, 2013

Table 6: Increasing Interest Rate Periods – US Treasury Rates (Bloomberg L.P. 2017, own graph)

	Development of US Interest Rates (bps)				
	Three-months	Two-years	Five-years	Ten-years	Thirty-years
Period	US0003M Index	USGG2YR Index	USGG5YR Index	USGG10YR Index	USGG30YR
05.01.1999-01.2000	101,7	196,2	205,8	192,2	128,3
08.11.2001-14.03.2002	-0,9	119,1	118,0	112,3	97,0
16.06.2003-02.09.2003	8,0	88,0	149,5	142,8	110,2
17.03.2004-14.06.2004	43,1	143,5	142,6	115,9	86,6
01.06.2005-30.06.2006	213,1	167,4	147,2	125,2	94,9
28.06.2005-04.11.2005	81,0	82,3	80,3	68,9	61,0
18.03.2008-13.06.2008	27,2	143,2	127,3	77,4	44,1
18.09.2008-17.10.2008	121,5	-8,0	20,5	38,6	13,4
01.12.2008-30.04.2010	-187,3	5,9	70,2	92,2	130,4
16.01.2009-08.06.2009	-49,2	67,7	145,5	155,5	173,9
01.12.2009-05.04.2010	3,6	49,7	70,1	70,4	56,6
05.11.2010-03.03.2011	2,4	39,3	119,0	102,5	50,0
02.07.2012-29.11.2013	-22,2	-1,6	71,7	116,6	111,3
03.05.2013-05.09.2013	-1,7	30,2	112,5	125,6	93,1

Periods where all interest rates increased

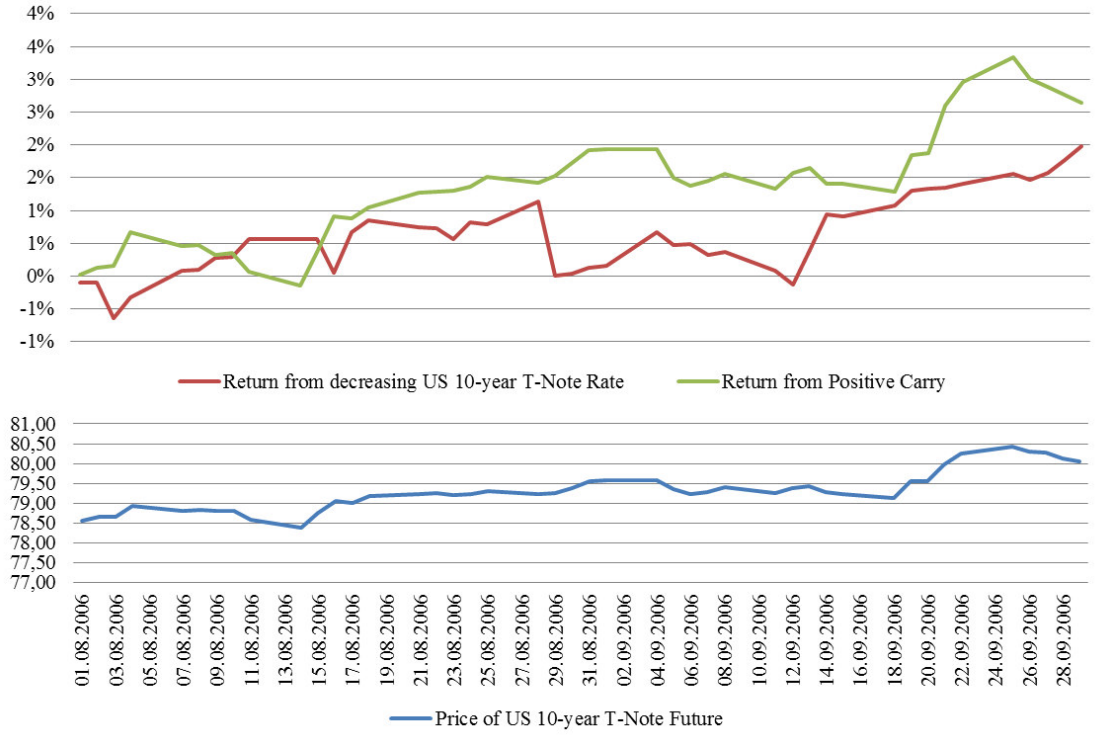
Table 7: Increasing Interest Rate Periods - German Treasury Rates (Bloomberg L.P. 2017, own graph)

	Development of German Interest Rates (bps)				
	Three-months	Two-years	Five-years	Ten-years	Thirty-years
Period	EUR003M Index	GDBR2 Index	GDBR5 Index	GDBR10 Index	GDBR30 Index
05.01.1999-01.2000	25,2	132,7	182,7	184,4	135,2
08.11.2001-14.03.2002	0,3	113,0	120,5	91,8	66,4
16.06.2003-02.09.2003	2,6	72,2	89,8	75,1	57,5
17.03.2004-14.06.2004	5,9	58,5	57,8	50,0	30,2
01.06.2005-30.06.2006	93,6	141,6	118,8	79,2	51,4
28.06.2005-04.11.2005	16,9	66,3	61,3	35,8	17,5
18.03.2008-13.06.2008	30,6	160,5	135,5	90,9	35,0
18.09.2008-17.10.2008	11,7	-73,2	-18,3	5,3	-17,1
01.12.2008-30.04.2010	-319,4	-139,0	-63,9	-19,6	5,5
16.01.2009-08.06.2009	-124,2	14,9	65,1	83,2	52,2
01.12.2009-05.04.2010	-8,4	-30,2	-10,1	-7,1	-10,9
05.11.2010-03.03.2011	4,5	61,8	86,3	80,1	80,2
02.07.2012-29.11.2013	-42,0	-0,3	4,6	11,2	31,2
03.05.2013-05.09.2013	1,8	30,6	72,9	77,6	61,1

Periods where all interest rates increased

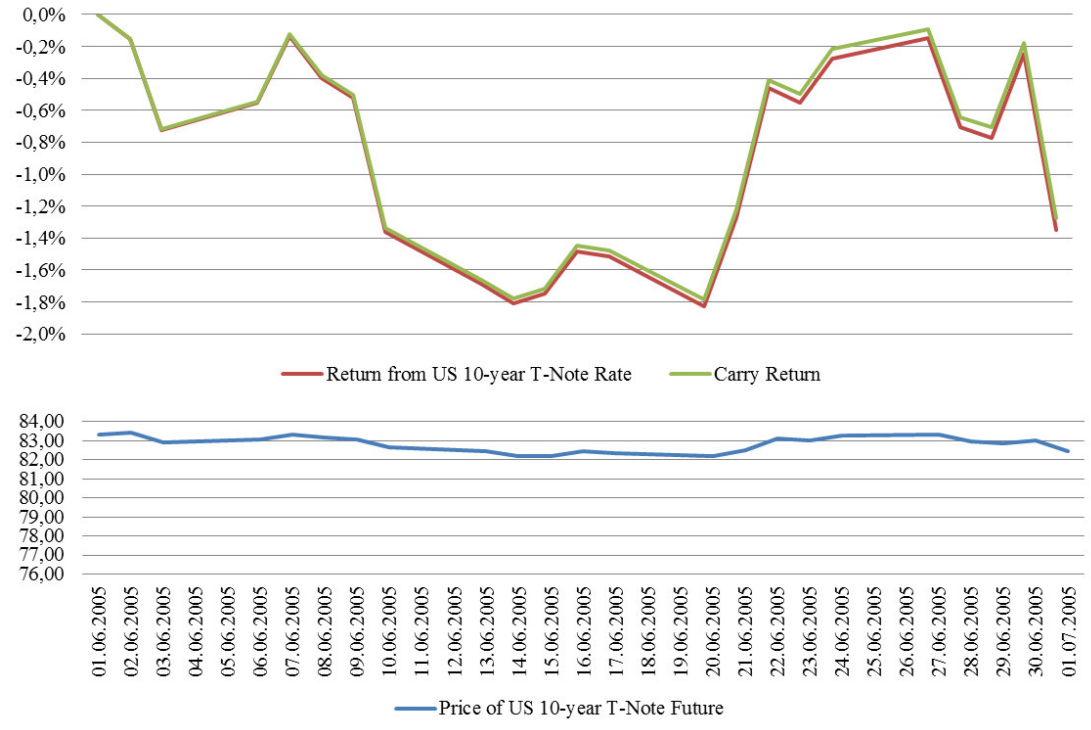
7.4. Return Sources of a Bond Future

Figure 2: Upwards Move of US 10-year T-Note Future between August 1st and September 29, 2006 (Bloomberg L.P. 2017, own graph)



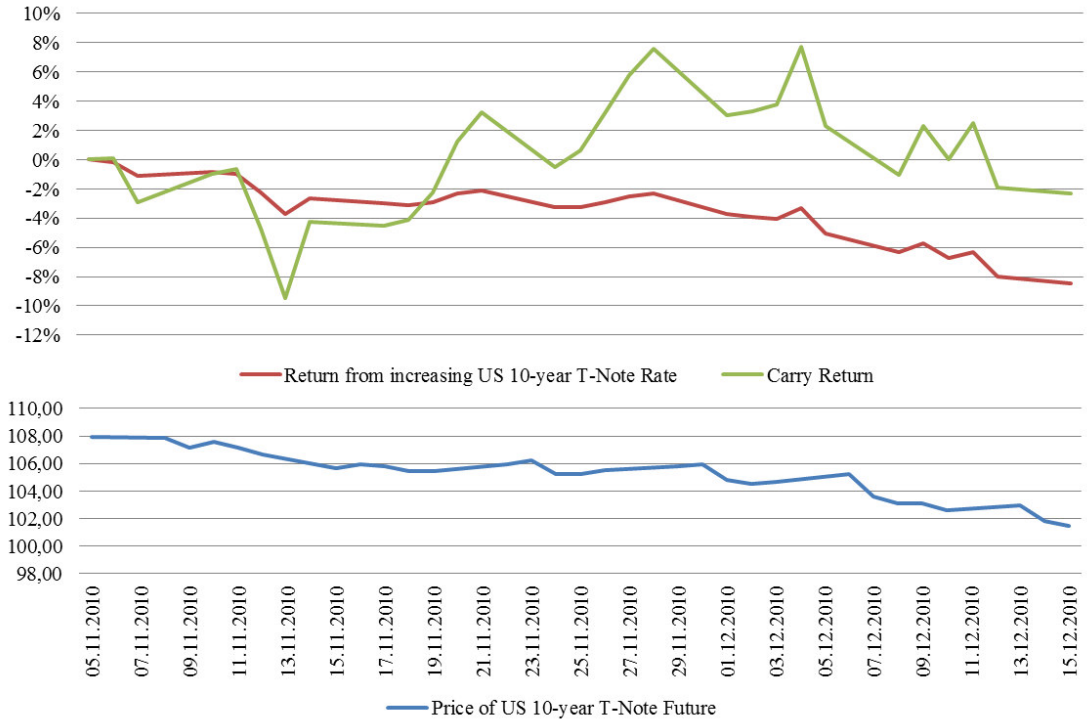
*The return developments of the t-note rate and carry are indexed to 0

Figure 3: Sideways Move of US 10-year T-Note Future between June 1st and July 1st, 2005 (Bloomberg L.P. 2017, own graph)



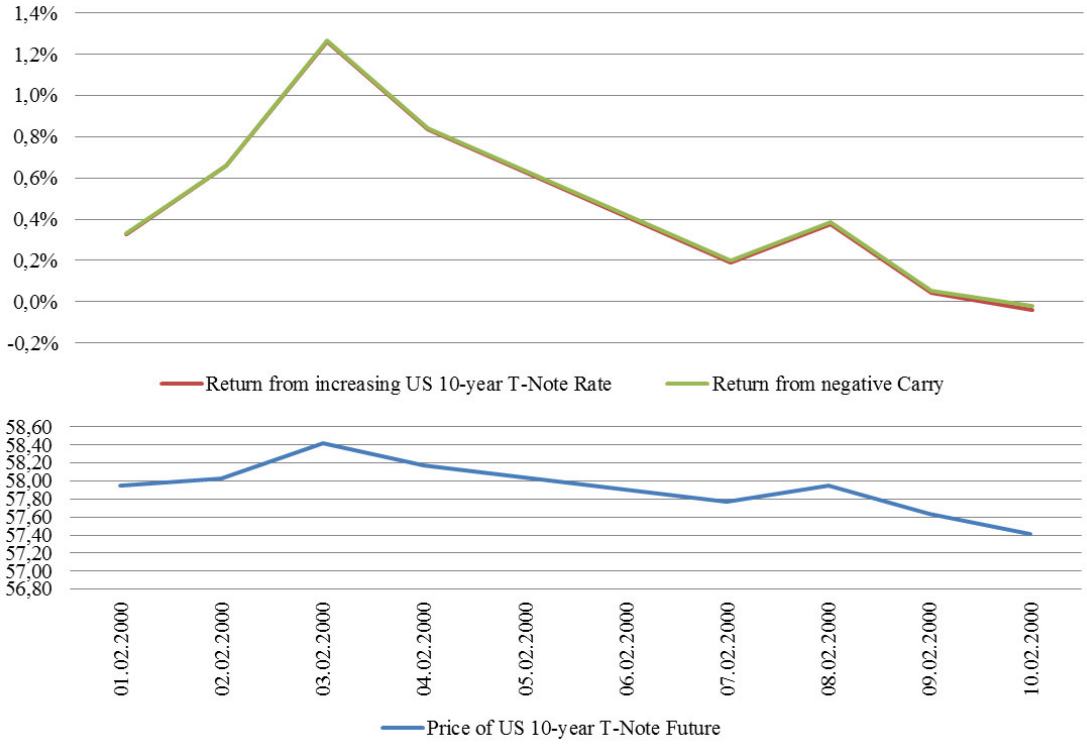
*The return developments of the t-note rate and carry are indexed to 0

Figure 4: Downwards Move of US 10-year T-Note Future between November 5 and December 15, 2010 (Bloomberg L.P. 2017, own graph)



*The return developments of the t-note rate and carry are indexed to 0

Figure 5: Inverted Yield Curve Structure from February 1st to 10, 2000 (Bloomberg L.P. 2017, own graph)



*The return developments of the t-note rate and carry are indexed to 0

7.5. Results

7.5.1. Investment Style Portfolios

Table 8: Results: Investment Style Portfolios - In-Sample (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0644%	0,0943%	0,1935%	0,2210%	0,4190%	-0,0011%	0,0192%	0,0946%	0,1764%	0,2352%	-0,0022%	0,0107%	0,1700%
p-value (RC)	0,889	0,096	0,186	0,137	0,3	0,488	0,467	0,417	0,016	0,051	0,232	0,874	0,84
Annualized Volatility	0,0634%	0,1376%	0,3181%	0,4620%	0,7032%	0,0298%	0,1007%	0,2410%	0,3525%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,0150	0,6850	0,6082	0,4783	0,5959	-0,0371	0,1904	0,3927	0,5003	0,3760	-0,0285	0,6917	0,6402

1. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,1544%	0,0322%	0,2397%	0,2601%	0,6688%	0,0048%	-0,2083%	-0,0029%	0,2914%	0,0427%	-0,0075%	0,0170%	0,1034%
p-value (RC)	0,944	0,467	0,369	0,102	0,043	0,46	0,793	0,792	0,771	0,08	0,203	0,839	0,945
Annualized Volatility	0,1355%	0,2952%	0,4880%	0,6651%	1,4063%	0,0673%	0,4693%	0,5053%	0,8870%	0,5653%	0,1033%	0,0187%	0,1502%
Annualized Sharpe Ratio	1,1398	0,1090	0,4911	0,3910	0,4756	0,0719	-0,4438	-0,0057	0,3285	0,0755	-0,0730	0,9069	0,6886

2. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,3097%	-0,1449%	-0,0512%	0,0824%	-0,0167%	0,0293%	-0,0812%	-0,0090%	-0,0171%	0,0000%	-0,0064%	0,0053%	0,0000%
p-value (RC)	0,974	0,388	0,271	0,548	0,147	0,458	0,667	0,741	1	1	0,149	1	1
Annualized Volatility	0,3606%	0,3763%	0,5775%	1,2787%	0,8192%	0,2008%	0,6075%	0,1658%	0,0456%	0,0000%	0,0183%	0,0064%	0,0000%
Annualized Sharpe Ratio	0,8588	-0,3850	-0,0887	0,0644	-0,0204	0,1461	-0,1337	-0,0542	-0,3750	0,0000	-0,3482	0,8325	0,0000

TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0254%	-0,0984%	-0,2176%	-0,2843%	-0,6635%	0,0214%	0,0145%	0,0066%	-0,1011%	-0,1691%	-0,0456%	-0,0016%	0,0648%
p-value (RC)	0,399	0,785	0,696	0,965	0,575	0,339	0,148	0,064	0,547	0,701	0,45	0,161	0,871
Annualized Volatility	0,0635%	0,1376%	0,3181%	0,4619%	0,7024%	0,0298%	0,1007%	0,2411%	0,3526%	0,6517%	0,0756%	0,0155%	0,2658%
Annualized Sharpe Ratio	0,3995	-0,7147	-0,6842	-0,6156	-0,9446	0,7194	0,1437	0,0274	-0,2868	-0,2595	-0,6041	-0,1036	0,2437

CSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0951%	-0,0540%	-0,3112%	-0,3931%	-0,6294%	0,0254%	0,0243%	-0,1673%	-0,0297%	-0,6479%	-0,0713%	-0,0107%	-0,0219%
p-value (RC)	0,753	0,975	0,892	0,347	0,706	0,304	0,407	0,729	0,398	0,999	0,888	1	0,189
Annualized Volatility	0,1976%	0,1744%	0,4292%	0,6838%	1,0526%	0,0799%	0,1286%	0,2919%	0,4507%	1,0189%	0,1502%	0,0199%	0,1378%
Annualized Sharpe Ratio	0,4815	-0,3097	-0,7249	-0,5748	-0,5979	0,3176	0,1890	-0,5732	-0,0658	-0,6359	-0,4750	-0,5365	-0,1593

TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0784%	0,1540%	0,2193%	0,2944%	0,3133%	-0,0011%	0,0411%	0,1012%	0,1420%	0,2343%	-0,0022%	0,0176%	0,1700%
p-value (RC)	0,837	0,256	0,171	0,17	0,147	0,508	0,258	0,271	0,104	0,06	0,23	0,417	0,815
Annualized Volatility	0,0633%	0,1374%	0,3180%	0,4618%	0,7034%	0,0298%	0,1007%	0,2410%	0,3526%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,2380	1,1206	0,6896	0,6376	0,4455	-0,0371	0,4079	0,4198	0,4028	0,3746	-0,0285	1,1382	0,6402

CSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,1523%	0,0340%	0,0358%	0,1719%	0,4361%	-0,0020%	0,0000%	0,0000%	0,6488%	0,8738%	0,0509%	-0,0111%	0,0000%
p-value (RC)	0,932	0	1	0	0,204	0,837	1	1	0,052	0,012	0,161	0,054	1
Annualized Volatility	0,4524%	0,0555%	0,1608%	0,5222%	1,1606%	0,0669%	0,0000%	0,0000%	0,7776%	1,1233%	0,2853%	0,0374%	0,0000%
Annualized Sharpe Ratio	0,3367	0,6120	0,2224	0,3292	0,3757	-0,0298	0,0000	0,0000	0,8344	0,7778	0,1786	-0,2956	0,0000

B&H	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0644%	0,0411%	0,2193%	0,2944%	0,3133%	-0,0011%	0,0411%	0,1012%	0,1420%	0,2343%	-0,0022%	0,0107%	0,1700%
Annualized Volatility	0,0634%	0,1007%	0,3180%	0,4618%	0,7034%	0,0298%	0,1007%	0,2410%	0,3526%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,0150	0,4079	0,6896	0,6376	0,4455	-0,0371	0,4079	0,4198	0,4028	0,3746	-0,0285	0,6917	0,6402

Table 9: Results: Investment Style Portfolios - Out-of-Sample (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0149%	0,0452%	0,1478%	0,2353%	0,3819%	0,0083%	-0,0115%	0,2622%	0,4321%	0,6602%	-0,0021%	0,0252%	0,0025%	0,1616%
p-value (RC)	0,737	0,928	0,952	0,887	0,767	0,134	0,995	0,672	0,424	0,582	0,588	0,750	0,587	0,642
Annualized Volatility	0,0197%	0,0568%	0,2182%	0,3655%	0,7283%	0,0193%	0,0627%	0,2104%	0,4150%	0,9333%	0,0398%	0,0683%	0,0078%	0,1603%
Annualized Sharpe Ratio	0,7543	0,7956	0,6775	0,6436	0,5244	0,4309	-0,1832	1,2463	1,0414	0,7074	-0,0519	0,3692	0,3168	1,0084

1. CSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0232%	0,0405%	0,1942%	0,2665%	0,3511%	0,0050%	0,0503%	0,3060%	0,2745%	0,3027%	-0,0051%	-0,0722%	0,0066%	0,0373%
p-value (RC)	0,360	0,938	0,964	0,101	0,226	0,904	0,618	0,343	0,033	0,238	0,409	0,162	0,629	0,678
Annualized Volatility	0,0339%	0,0651%	0,3037%	0,5174%	0,8767%	0,0441%	0,1139%	0,2938%	0,2435%	0,4891%	0,0774%	0,4471%	0,0408%	0,0457%
Annualized Sharpe Ratio	0,6854	0,6218	0,6394	0,5150	0,4005	0,1134	0,4418	1,0415	1,1276	0,6190	-0,0655	-0,1615	0,1618	0,8176

2. CSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0172%	0,0051%	0,0923%	0,0048%	0,0000%	-0,0090%	-0,2961%	-0,0347%	0,0000%	0,0000%	0,0048%	0,0068%	0,0047%	0,0000%
p-value (RC)	1,000	1,000	1,000	0,840	0,693	0,974	0,699	1,000	1,000	0,939	0,553	0,018	0,000	1,000
Annualized Volatility	0,0468%	0,0491%	0,2094%	0,0101%	0,0000%	0,0576%	0,6611%	0,1868%	0,0000%	0,0000%	0,3822%	0,0366%	0,0247%	0,0000%
Annualized Sharpe Ratio	0,3678	0,1043	0,4406	0,4738	0,0000	-0,1566	-0,4479	-0,1857	0,0000	0,0000	0,0127	0,1863	0,1888	0,0000

TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0166%	-0,0071%	-0,1095%	0,0047%	0,0198%	0,0058%	-0,0238%	-0,0713%	-0,1623%	-0,0158%	0,0362%	0,0030%	0,0046%	-0,0449%
p-value (RC)	0,814	0,336	0,230	0,017	0,045	0,626	0,547	0,727	0,688	0,016	0,082	0,858	0,337	0,497
Annualized Volatility	0,0197%	0,0567%	0,2180%	0,3656%	0,7285%	0,0193%	0,0623%	0,2103%	0,4150%	0,8958%	0,5571%	0,0683%	0,0078%	0,1607%
Annualized Sharpe Ratio	0,8432	-0,1253	-0,5023	0,0129	0,0271	0,3033	-0,3816	-0,3389	-0,3910	-0,0176	0,0650	0,0433	0,5838	-0,2792

CSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0017%	-0,0333%	-0,3063%	-0,0123%	0,0433%	-0,0004%	0,0031%	-0,0393%	-0,1753%	0,5176%	-0,0003%	-0,0180%	0,0003%	-0,2332%
p-value (RC)	0,725	0,155	0,396	0,144	0,529	0,731	0,099	0,594	0,830	0,158	0,010	0,744	0,732	0,457
Annualized Volatility	0,0136%	0,1503%	0,3879%	0,3721%	0,5660%	0,0108%	0,1669%	0,4779%	0,5563%	0,8818%	0,0105%	0,0478%	0,0050%	0,4784%
Annualized Sharpe Ratio	0,1256	-0,2214	-0,7896	-0,0331	0,0766	-0,0379	0,0185	-0,0822	-0,3152	0,5870	-0,0285	-0,3769	0,0526	-0,4875

TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0071%	0,0259%	0,1995%	0,2353%	0,3819%	-0,0080%	-0,0350%	0,0444%	0,3846%	1,0790%	-0,0018%	0,0376%	-0,0020%	-0,0486%
p-value (RC)	0,157	0,235	0,978	0,840	0,724	0,734	0,902	0,946	0,417	0,306	0,542	0,569	0,335	0,742
Annualized Volatility	0,0198%	0,0569%	0,2180%	0,3655%	0,7283%	0,0193%	0,0627%	0,2110%	0,4151%	0,9317%	0,0398%	0,0683%	0,0079%	0,1606%
Annualized Sharpe Ratio	-0,3582	0,4564	0,9151	0,6436	0,5244	-0,4133	-0,5586	0,2105	0,9265	1,1581	-0,0455	0,5513	-0,2539	-0,3024

CSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0398%	-0,0047%	1,7561%	0,0175%	0,0158%	-0,0222%	-0,0102%	-0,0160%	0,0038%	0,0058%	0,0097%	0,0026%	-0,0081%	-0,3266%
p-value (RC)	0,336	0,245	0,000	0,757	0,502	0,906	0,947	1,000	0,000	1,000	0,469	0,349	0,339	0,925
Annualized Volatility	0,0452%	0,0158%	4,2652%	0,0415%	0,0407%	0,0496%	0,0202%	0,0228%	0,0196%	0,0072%	0,1578%	0,0086%	0,0223%	0,9430%
Annualized Sharpe Ratio	-0,8793	-0,2992	0,4117	0,4226	0,3872	-0,4471	-0,5041	-0,7025	0,1952	0,8057	0,0615	0,2986	-0,3652	-0,3464

B&H	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0149%	0,0394%	0,1478%	0,2353%	0,3819%	0,0108%	0,0516%	0,2339%	0,4321%	0,6602%	-0,0021%	0,0376%	0,0027%	0,1476%
Annualized Volatility	0,0197%	0,0568%	0,2182%	0,3655%	0,7283%	0,0193%	0,0626%	0,2105%	0,4150%	0,9333%	0,0398%	0,0683%	0,0078%	0,1603%
Annualized Sharpe Ratio	0,7543	0,6940	0,6775	0,6436	0,5244	0,5615	0,8247	1,1110	1,0414	0,7074	-0,0519	0,5513	0,3405	0,9204

Table 10: Results: Investment Style Portfolios - 16.06.2003-02.09.2003 (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,2600%	-0,3440%	-1,7306%	-2,7364%	-4,6480%	-0,1268%	-0,1436%	-1,3760%	-1,9093%	-2,4606%	-0,3751%	-0,0684%	-2,3755%
p-value (RC)	0,996	0,991	0,866	0,768	0,678	1,000	0,996	0,904	0,824	0,719	0,995	1,000	0,841
Annualized Volatility	0,0973%	0,1670%	0,4433%	0,7158%	1,1183%	0,0354%	0,1505%	0,3953%	0,5830%	0,9198%	0,0973%	0,0176%	0,4954%
Annualized Sharpe Ratio	-2,6716	-2,0599	-3,9034	-3,8229	-4,1562	-3,5793	-0,9543	-3,4810	-3,2748	-2,6752	-3,8566	-3,8760	-4,7955

1. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,4351%	0,3461%	-1,8494%	-3,8462%	-1,4506%	-0,2536%	-0,1826%	-1,2120%	-2,1144%	-2,2755%	-0,6628%	-0,0205%	-1,0556%
p-value (RC)	1	0,597	0,541	0,662	0,567	0,996	0,877	0,851	0,974	0,658	0,902	0,999	0,681
Annualized Volatility	0,1780%	0,5021%	0,7528%	1,0555%	2,4206%	0,0731%	0,0956%	0,3470%	0,6540%	0,8306%	0,1444%	0,0046%	0,1987%
Annualized Sharpe Ratio	-2,4441	0,6893	-2,4566	-3,6441	-0,5993	-3,4684	-1,9111	-3,4931	-3,2331	-2,7395	-4,5914	-4,4313	-5,3126

2. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-1,1504%	0,7060%	-0,7555%	0,1721%	0,0000%	-1,0006%	0,0229%	0,0000%	0,0000%	0,0000%	-0,2322%	0,0000%	0,0000%
p-value (RC)	0,998	0,795	0,999	0,999	0,54	0,992	0,817	0,917	0,996	1	0,818	1	1
Annualized Volatility	0,4248%	0,6395%	0,9544%	0,0573%	0,0000%	0,2816%	0,3330%	0,0000%	0,0000%	0,0000%	0,0448%	0,0000%	0,0000%
Annualized Sharpe Ratio	-2,7079	1,1040	-0,7916	3,0027	0,0000	-3,5528	0,0688	0,0000	0,0000	0,0000	-5,1784	0,0000	0,0000

TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0541%	-0,1318%	0,2324%	-0,3899%	-0,6692%	0,0196%	-0,0627%	-0,3956%	-1,4895%	-0,4879%	-0,3854%	0,0340%	0,7592%
p-value (RC)	0,996	0,997	0,976	0,886	0,8	0,997	0,994	0,963	0,929	0,965	0,997	0,998	0,956
Annualized Volatility	0,0988%	0,1676%	0,4591%	0,7389%	1,1613%	0,0365%	0,1506%	0,4063%	0,5885%	0,4874%	0,0967%	0,0180%	0,5165%
Annualized Sharpe Ratio	0,5476	-0,7868	0,5062	-0,5277	-0,5763	0,5369	-0,4166	-0,9735	-2,5313	-1,0011	-3,9861	1,8859	1,4698

CSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1674%	0,0979%	-1,4758%	1,3508%	-4,6228%	0,2164%	0,7136%	-0,0430%	-0,8974%	-1,2714%	-0,1215%	-0,1016%	0,2160%
p-value (RC)	0,996	0,995	0,903	0,873	0,751	0,996	0,988	0,954	0,946	0,925	0,996	0,999	0,988
Annualized Volatility	0,0973%	0,2045%	0,7486%	0,8944%	1,5217%	0,0884%	0,2783%	0,4863%	0,6347%	0,6750%	0,1393%	0,0239%	0,2716%
Annualized Sharpe Ratio	-1,7201	0,4785	-1,9715	1,5102	-3,0380	2,4471	2,5638	-0,0883	-1,4139	-1,8837	-0,8724	-4,2423	0,7950

TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,2606%	0,0267%	-1,7306%	-2,7364%	-4,6480%	-0,1268%	-0,4676%	-1,3760%	-1,9093%	-2,4606%	-0,3751%	0,0003%	-2,3755%
p-value (RC)	1	0,996	0,919	0,87	0,809	1	0,996	0,91	0,859	0,723	0,999	1	0,994
Annualized Volatility	0,0973%	0,1679%	0,4433%	0,7158%	1,1183%	0,0354%	0,1470%	0,3953%	0,5830%	0,9198%	0,0973%	0,0181%	0,4954%
Annualized Sharpe Ratio	2,6776	0,1588	-3,9034	-3,8229	-4,1562	-3,5793	-3,1818	-3,4810	-3,2748	-2,6752	-3,8566	0,0174	-4,7955

CSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	2,8395%	0,1740%	0,0000%	0,0000%	0,0000%	0,0000%	0,0000%	0,0000%	-0,5719%	-0,3451%	-0,1164%	0,2133%	0,0000%
p-value (RC)	0,969	0,998	0,996	0,999	0,998	0,999	0,997	1	0,786	0,668	0,983	0,999	0,998
Annualized Volatility	1,0986%	0,0520%	0,0000%	0,0000%	0,0000%	0,0000%	0,0000%	0,0000%	0,1910%	0,1577%	0,0347%	0,0609%	0,0000%
Annualized Sharpe Ratio	2,5847	3,3451	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	-2,9937	-2,1888	-3,3546	3,5046	0,0000

B&H	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,2600%	-0,4676%	-1,7306%	-2,7364%	-4,6480%	-0,1268%	-0,4676%	-1,3760%	-1,9093%	-2,4606%	-0,3751%	-0,0684%	-2,3755%
Annualized Volatility	0,0973%	0,1470%	0,4433%	0,7158%	1,1183%	0,0354%	0,1470%	0,3953%	0,5830%	0,9198%	0,0973%	0,0176%	0,4954%
Annualized Sharpe Ratio	-2,6716	-3,1818	-3,9034	-3,8229	-4,1562	-3,5793	-3,1818	-3,4810	-3,2748	-2,6752	-3,8566	-3,8760	-4,7955

Table 11: Results: Investment Style Portfolios - 17.03.2004-14.06.2004 (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,2598%	-0,6492%	-1,4875%	-2,0659%	-3,1232%	-0,0664%	-0,2679%	-0,7041%	-0,9819%	-1,0984%	-0,2145%	-0,0272%	-0,8106%
p-value (RC)	0,998	0,992	0,981	0,952	0,894	1,000	0,999	0,992	0,982	0,962	0,998	0,997	0,974
Annualized Volatility	0,0555%	0,1514%	0,3478%	0,5057%	0,7080%	0,0287%	0,1020%	0,2384%	0,3097%	0,4635%	0,0773%	0,0168%	0,3271%
Annualized Sharpe Ratio	-4,6854	-4,2885	-4,2765	-4,0854	-4,4113	-2,3149	-2,6269	-2,9541	-3,1702	-2,3695	-2,7747	-1,6202	-2,4778

1. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,4609%	-0,8448%	-2,1798%	-2,6715%	-3,3003%	-0,1415%	1,1958%	1,2941%	-1,0121%	-0,9520%	-0,2528%	-0,0047%	-0,3122%
p-value (RC)	0,996	0,985	0,993	0,853	0,667	0,998	0,987	0,989	0,999	0,9	0,987	0,997	0,914
Annualized Volatility	0,0979%	0,2126%	0,4983%	0,6383%	0,7517%	0,0583%	0,5778%	0,6799%	0,3368%	0,3362%	0,0818%	0,0025%	0,1181%
Annualized Sharpe Ratio	-4,7060	-3,9735	-4,3742	-4,1855	-4,3904	-2,4266	2,0695	1,9034	-3,0050	-2,8316	-3,0898	-1,8752	-2,6442

2. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-1,2366%	-0,3569%	-0,8213%	0,0000%	0,0000%	-0,4601%	0,0000%	0,0000%	0,0000%	0,0000%	-0,0151%	0,0000%	0,0000%
p-value (RC)	0,998	0,999	0,998	0,986	0,655	0,999	0,998	0,999	0,996	1	0,965	1	0,996
Annualized Volatility	0,2619%	0,1649%	0,1888%	0,0000%	0,0000%	0,2138%	0,0000%	0,0000%	0,0000%	0,0000%	0,0076%	0,0000%	0,0000%
Annualized Sharpe Ratio	-4,7209	-2,1647	-4,3510	0,0000	0,0000	-2,1521	0,0000	0,0000	0,0000	0,0000	-1,9842	0,0000	0,0000

TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0728%	-0,0510%	-0,3620%	-1,2158%	-1,3747%	-0,0788%	-0,2520%	-1,0329%	-1,4370%	-0,8211%	-0,2475%	0,0425%	0,0354%
p-value (RC)	0,996	0,994	0,975	0,962	0,88	0,993	0,999	0,993	0,98	0,934	0,999	0,993	0,984
Annualized Volatility	0,0577%	0,1569%	0,3599%	0,5170%	0,7307%	0,0286%	0,1021%	0,2337%	0,3028%	0,5967%	0,0764%	0,0167%	0,3316%
Annualized Sharpe Ratio	1,2618	-0,3250	-1,0058	-2,3517	-1,8813	-2,7559	-2,4676	-4,4192	-4,7456	-1,3762	-3,2385	2,5517	0,1068

CSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,4639%	-0,3094%	-1,1474%	0,2416%	0,7976%	-0,0958%	-0,2331%	-1,3239%	-1,0389%	-0,5223%	-0,6951%	0,0080%	0,0246%
p-value (RC)	0,998	0,996	0,958	0,829	0,828	0,996	0,998	0,989	0,988	0,898	0,993	0,997	0,995
Annualized Volatility	0,0946%	0,1270%	0,4494%	0,9878%	1,0598%	0,0899%	0,1630%	0,2414%	0,3243%	0,7273%	0,2203%	0,0142%	0,1318%
Annualized Sharpe Ratio	4,9027	-2,4359	-2,5531	0,2446	0,7526	-1,0658	-1,4302	-5,4852	-3,2037	-0,7181	-3,1555	0,5618	0,1870

TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,2605%	-0,2557%	-1,4875%	-2,0659%	-3,1232%	-0,0664%	-0,2846%	-0,7041%	-0,9819%	-1,0984%	-0,2145%	0,0272%	-0,8106%
p-value (RC)	0,999	0,996	0,982	0,943	0,889	0,995	0,995	0,989	0,982	0,949	0,998	0,998	0,984
Annualized Volatility	0,0555%	0,1561%	0,3478%	0,5057%	0,7080%	0,0287%	0,1018%	0,2384%	0,3097%	0,4635%	0,0773%	0,0168%	0,3271%
Annualized Sharpe Ratio	4,6970	-1,6374	-4,2765	-4,0854	-4,4113	-2,3149	-2,7950	-2,9541	-3,1702	-2,3695	-2,7747	1,6205	-2,4778

CSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	1,6213%	0,1495%	0,0000%	0,0000%	-0,1496%	0,0000%	0,0000%	0,0000%	-0,1008%	-0,0977%	-0,0446%	0,2673%	0,0000%
p-value (RC)	0,993	0,999	0,998	0,996	0,827	0,995	0,997	0,996	0,946	0,815	0,991	0,997	0,999
Annualized Volatility	0,3443%	0,0572%	0,0000%	0,0000%	0,0422%	0,0000%	0,0000%	0,0000%	0,0458%	0,0460%	0,0160%	0,1358%	0,0000%
Annualized Sharpe Ratio	4,7090	2,6147	0,0000	0,0000	-3,5487	0,0000	0,0000	0,0000	-2,2028	-2,1230	-2,7847	1,9690	0,0000

B&H	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,2598%	-0,2846%	-1,4875%	-2,0659%	-3,1232%	-0,0664%	-0,2846%	-0,7041%	-0,9819%	-1,0984%	-0,2145%	-0,0272%	-0,8106%
Annualized Volatility	0,0555%	0,1018%	0,3478%	0,5057%	0,7080%	0,0287%	0,1018%	0,2384%	0,3097%	0,4635%	0,0773%	0,0168%	0,3271%
Annualized Sharpe Ratio	-4,6854	-2,7950	-4,2765	-4,0854	-4,4113	-2,3149	-2,7950	-2,9541	-3,1702	-2,3695	-2,7747	-1,6202	-2,4778

Table 12: Results: Investment Style Portfolios - 28.06.2005-14.11.2005 (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1710%	-0,2333%	-0,5420%	-0,7911%	-1,1343%	-0,0784%	-0,1494%	-0,4509%	-0,5486%	-0,6104%	-0,0683%	-0,0320%	-0,4320%
p-value (RC)	0,997	0,998	0,987	0,976	0,912	0,999	0,890	0,994	0,978	0,894	0,998	0,997	0,982
Annualized Volatility	0,0530%	0,0869%	0,2125%	0,3384%	0,5410%	0,0173%	0,0630%	0,1650%	0,2755%	0,5741%	0,0598%	0,0163%	0,2459%
Annualized Sharpe Ratio	-3,2290	-2,6859	-2,5511	-2,3379	-2,0967	-4,5395	-2,3714	-2,7333	-1,9913	-1,0633	-1,1423	-1,9639	-1,7566

1. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,3278%	-0,3210%	-0,6857%	-1,1756%	-1,7307%	-0,1358%	0,2025%	-0,2214%	-0,3712%	-0,3323%	-0,0661%	-0,0050%	-0,1465%
p-value (RC)	0,994	0,994	0,994	0,995	0,883	0,997	0,989	0,964	0,993	0,781	0,986	0,999	0,967
Annualized Volatility	0,0994%	0,1284%	0,2902%	0,4581%	0,6722%	0,0297%	0,1753%	0,1655%	0,1734%	0,2808%	0,0619%	0,0024%	0,0732%
Annualized Sharpe Ratio	-3,2989	-2,4996	-2,3625	-2,5665	-2,5748	-4,5790	1,1551	-1,3379	-2,1407	-1,1833	-1,0672	-2,1170	-2,0007

2. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-1,3864%	-0,1264%	-0,1615%	0,0000%	0,0000%	-0,3156%	0,7179%	0,0000%	0,0000%	0,0000%	-0,0025%	0,0000%	0,0000%
p-value (RC)	0,97	0,999	0,998	0,996	0,998	0,996	0,982	0,999	1	0,998	0,985	0,995	1
Annualized Volatility	0,4325%	0,0630%	0,0668%	0,0000%	0,0000%	0,0697%	0,3070%	0,0000%	0,0000%	0,0000%	0,0062%	0,0000%	0,0000%
Annualized Sharpe Ratio	-3,2052	-2,0059	-2,4164	0,0000	0,0000	-4,5252	2,3385	0,0000	0,0000	0,0000	-0,3998	0,0000	0,0000

TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,1369%	0,0362%	0,1881%	0,3796%	-0,0818%	0,0129%	-0,0078%	0,2504%	-0,3532%	-1,1802%	-0,1117%	-0,0207%	-0,6909%
p-value (RC)	0,996	0,998	0,982	0,988	0,908	0,998	0,998	0,991	0,982	0,927	0,998	0,998	0,987
Annualized Volatility	0,0534%	0,0883%	0,2157%	0,3424%	0,5467%	0,0180%	0,0636%	0,1672%	0,2770%	0,5039%	0,0595%	0,0164%	0,2435%
Annualized Sharpe Ratio	2,5638	0,4097	0,8721	1,1087	-0,1496	0,7176	-0,1229	1,4970	-1,2752	-2,3421	-1,8762	-1,2634	-2,8381

CSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,5274%	0,0750%	-0,1767%	-0,0045%	-0,6860%	-0,0241%	-0,0744%	0,0241%	-0,0876%	-1,5261%	-0,1873%	-0,0354%	-0,1916%
p-value (RC)	0,997	0,989	0,98	0,948	0,907	0,997	0,999	0,996	0,988	0,908	0,998	0,995	0,995
Annualized Volatility	0,1351%	0,0738%	0,2442%	0,4329%	0,7792%	0,0509%	0,0422%	0,1308%	0,3913%	0,7823%	0,1410%	0,0234%	0,1596%
Annualized Sharpe Ratio	3,9023	1,0167	-0,7233	-0,0103	-0,8803	-0,4723	-1,7651	0,1839	-0,2239	-1,9508	-1,3289	-1,5115	-1,2003

TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1710%	-0,2427%	-0,5420%	-0,7911%	-1,1343%	-0,0784%	-0,2397%	-0,4509%	-0,5486%	-0,6104%	-0,0683%	0,0281%	-0,4320%
p-value (RC)	0,996	0,997	0,993	0,968	0,902	0,997	0,996	0,996	0,982	0,902	0,993	0,998	0,991
Annualized Volatility	0,0530%	0,0867%	0,2125%	0,3384%	0,5410%	0,0173%	0,0616%	0,1650%	0,2755%	0,5741%	0,0598%	0,0163%	0,2459%
Annualized Sharpe Ratio	-3,2290	-2,7985	-2,5511	-2,3379	-2,0967	-4,5395	-3,8933	-2,7333	-1,9913	-1,0633	-1,1423	1,7202	-1,7566

CSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0000%	0,0000%	0,0000%	0,0000%	-0,1693%	0,0000%	0,0000%	0,0000%	0,0709%	-0,0319%	-0,0165%	0,3683%	0,0000%
p-value (RC)	0,998	0,999	0,998	0,999	0,664	0,996	0,997	0,995	0,988	0,647	0,988	0,998	0,996
Annualized Volatility	0,0000%	0,0000%	0,0000%	0,0000%	0,0968%	0,0000%	0,0000%	0,0000%	0,3320%	0,4642%	0,0563%	0,1989%	0,0000%
Annualized Sharpe Ratio	0,0000	0,0000	0,0000	0,0000	-1,7504	0,0000	0,0000	0,0000	0,2137	-0,0687	-0,2936	1,8512	0,0000

B&H	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1710%	-0,2397%	-0,5420%	-0,7911%	-1,1343%	-0,0784%	-0,2397%	-0,4509%	-0,5486%	-0,6104%	-0,0683%	-0,0320%	-0,4320%
Annualized Volatility	0,0530%	0,0616%	0,2125%	0,3384%	0,5410%	0,0173%	0,0616%	0,1650%	0,2755%	0,5741%	0,0598%	0,0163%	0,2459%
Annualized Sharpe Ratio	-3,2290	-3,8933	-2,5511	-2,3379	-2,0967	-4,5395	-3,8933	-2,7333	-1,9913	-1,0633	-1,1423	-1,9639	-1,7566

Table 13: Results: Investment Style Portfolios - 01.06.2005-01.06.2006 (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0908%	0,0526%	0,2127%	0,1102%	-0,0446%	-0,0372%	-0,0312%	-0,2705%	-0,3455%	-0,4602%	-0,0005%	-0,0293%	-0,3083%
p-value (RC)	0,871	0,066	0,134	0,100	0,010	0,583	0,770	0,883	0,865	0,841	0,742	0,991	0,829
Annualized Volatility	0,0442%	0,0850%	0,2059%	0,3209%	0,5167%	0,0209%	0,0683%	0,1860%	0,3060%	0,6182%	0,0544%	0,0203%	0,2602%
Annualized Sharpe Ratio	-2,0533	0,6186	1,0332	0,3433	-0,0864	-1,7774	-0,4567	-1,4543	-1,1288	-0,7444	-0,0090	-1,4455	-1,1846

1. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1714%	-0,2226%	-0,4882%	-0,8089%	-1,1990%	-0,0641%	0,0739%	-0,1451%	-0,2137%	-0,1006%	-0,0359%	-0,0106%	-0,0750%
p-value (RC)	0,874	0,018	0	0	0,006	0,594	0,478	0,833	0,988	0,893	0,74	0,087	0,551
Annualized Volatility	0,0827%	0,1146%	0,2720%	0,4329%	0,6946%	0,0359%	0,1243%	0,1884%	0,1809%	0,2657%	0,0501%	0,0092%	0,0717%
Annualized Sharpe Ratio	-2,0731	-1,9428	-1,7950	-1,8687	-1,7261	-1,7853	0,5942	-0,7699	-1,1817	-0,3785	-0,7175	-1,1579	-1,0460

2. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,7469%	-0,0817%	-0,1118%	3,6305%	1,0099%	-0,1500%	0,4213%	0,0000%	0,0000%	0,0000%	0,0000%	-0,0007%	0,0000%
p-value (RC)	0,903	1	0	0	0	0,598	0,511	1	1	1	0,693	1	1
Annualized Volatility	0,3622%	0,0568%	0,1041%	1,5470%	0,5049%	0,0868%	0,2908%	0,0000%	0,0000%	0,0000%	0,0045%	0,0012%	0,0000%
Annualized Sharpe Ratio	-2,0621	-1,4388	-1,0737	2,3468	2,0003	-1,7271	1,4485	0,0000	0,0000	0,0000	-0,0039	-0,5564	0,0000

TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0590%	-0,1054%	-0,2584%	-0,2874%	-0,6673%	-0,0024%	-0,0179%	0,1531%	-0,2254%	-0,7893%	-0,0845%	0,0276%	-0,5730%
p-value (RC)	0,259	0,898	0,894	0,816	0,838	0,664	0,273	0,393	0,613	0,798	0,782	0,04	0,977
Annualized Volatility	0,0444%	0,0847%	0,2060%	0,3207%	0,5147%	0,0211%	0,0683%	0,1865%	0,3063%	0,5076%	0,0542%	0,0203%	0,2585%
Annualized Sharpe Ratio	1,3280	-1,2437	-1,2542	-0,8962	-1,2967	-0,1118	-0,2617	0,8210	-0,7359	-1,5550	-1,5585	1,3601	-2,2168

CSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,2419%	-0,0453%	-0,3373%	-0,4590%	-0,8596%	0,0155%	-0,0329%	-0,0075%	-0,3656%	-1,5737%	-0,1131%	-0,0226%	-0,3760%
p-value (RC)	0,221	0,851	0,944	0,78	0,665	0,403	0,409	0,703	0,911	0,971	0,418	0,825	0,995
Annualized Volatility	0,1185%	0,0750%	0,2350%	0,4106%	0,7358%	0,0526%	0,0545%	0,1618%	0,4003%	0,7893%	0,1234%	0,0251%	0,1557%
Annualized Sharpe Ratio	2,0418	-0,6038	-1,4352	-1,1177	-1,1682	0,2939	-0,6031	-0,0463	-0,9133	-1,9938	-0,9164	-0,9006	-2,4150

TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0908%	-0,1651%	-0,3552%	-0,5023%	-0,7301%	-0,0372%	-0,1120%	-0,2705%	-0,3455%	-0,4602%	-0,0491%	0,0323%	-0,3083%
p-value (RC)	0,915	0,901	0,87	0,866	0,88	0,586	0,792	0,884	0,857	0,861	0,047	0,77	0,01
Annualized Volatility	0,0442%	0,0846%	0,2055%	0,3197%	0,5150%	0,0209%	0,0680%	0,1860%	0,3060%	0,6182%	0,0544%	0,0202%	0,2602%
Annualized Sharpe Ratio	-2,0533	-1,9529	-1,7286	-1,5712	-1,4177	-1,7774	-1,6478	-1,4543	-1,1288	-0,7444	-0,9029	1,5962	-1,1846

CSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1843%	-0,0136%	0,2491%	-0,0020%	-0,0426%	0,0000%	0,0000%	0,0000%	-0,0162%	-0,0280%	-0,1032%	0,1903%	0,0000%
p-value (RC)	1	1	1	1	0,563	1	1	1	0,632	0,568	0,754	0,058	1
Annualized Volatility	0,1066%	0,0159%	0,4244%	0,0021%	0,0722%	0,0000%	0,0000%	0,0000%	0,8486%	0,9291%	0,1293%	0,1577%	0,0000%
Annualized Sharpe Ratio	-1,7281	-0,8550	0,5869	-0,9807	-0,5908	0,0000	0,0000	0,0000	-0,0191	-0,0301	-0,7984	1,2065	0,0000

B&H	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0908%	-0,1120%	-0,3552%	-0,5023%	-0,7301%	-0,0372%	-0,1120%	-0,2705%	-0,3455%	-0,4602%	-0,0491%	-0,0293%	-0,3083%
Annualized Volatility	0,0442%	0,0680%	0,2055%	0,3197%	0,5150%	0,0209%	0,0680%	0,1860%	0,3060%	0,6182%	0,0544%	0,0203%	0,2602%
Annualized Sharpe Ratio	-2,0533	-1,6478	-1,7286	-1,5712	-1,4177	-1,7774	-1,6478	-1,4543	-1,1288	-0,7444	-0,9029	-1,4455	-1,1846

Table 14: Results: Investment Style Portfolios - 05.11.2010-03.03.2011 (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0422%	-0,0969%	-0,7218%	-1,2495%	-1,5158%	-0,0247%	-0,1871%	-0,7051%	-1,1356%	-2,5200%	0,0312%	-0,0591%	-0,0095%	-0,3901%
p-value (RC)	0,015	1	0,962	0,982	0,959	0,814	0,469	0,982	0,992	0,933	0,088	0,821	0,774	0,919
Annualized Volatility	0,0167%	0,0945%	0,3458%	0,5370%	0,9001%	0,0281%	0,1095%	0,2894%	0,4385%	0,8896%	0,0173%	0,0609%	0,0113%	0,2670%
Annualized Sharpe Ratio	2,5292	-1,0255	-2,0871	-2,3270	-1,6840	-0,8818	-1,7085	-2,4367	-2,5894	-2,8327	1,8049	-0,9701	-0,8443	-1,4609

1. CSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0641%	-0,0864%	-0,7181%	-1,6077%	-1,5150%	-0,0426%	-0,5158%	-1,6509%	-0,6078%	-1,0005%	0,0006%	0,0052%	-0,0091%	-0,1436%
p-value (RC)	0,030	0,867	0,998	0,027	0,050	0,314	0,980	0,588	0,033	0,013	0,936	0,992	0,755	0,932
Annualized Volatility	0,0233%	0,0743%	0,3871%	0,6368%	0,8749%	0,0488%	0,2996%	0,5021%	0,2544%	0,3651%	0,0324%	0,0102%	0,0081%	0,0649%
Annualized Sharpe Ratio	2,7544	-1,1630	-1,8553	-2,5247	-1,7316	-0,8744	-1,7220	-3,2878	-2,3893	-2,7400	0,0180	0,5065	-1,1163	-2,2129

2. CSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0418%	0,0000%	-0,2539%	-0,0178%	0,0000%	-0,0559%	2,1805%	0,0000%	0,0000%	0,0000%	0,3283%	0,0000%	0,0000%	0,0000%
p-value (RC)	1,000	1,000	1,000	0,959	0,939	0,011	0,024	1,000	1,000	0,923	0,075	1,000	1,000	1,000
Annualized Volatility	0,0153%	0,0000%	0,1527%	0,0165%	0,0000%	0,0640%	0,9325%	0,0000%	0,0000%	0,0000%	0,1815%	0,0000%	0,0000%	0,0000%
Annualized Sharpe Ratio	2,7328	0,0000	-1,6633	-1,0781	0,0000	-0,8727	2,3383	0,0000	0,0000	0,0000	1,8089	0,0000	0,0000	0,0000

TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0396%	-0,1003%	-0,4106%	0,6189%	0,6526%	0,0184%	0,0568%	0,0508%	-0,5505%	0,7295%	0,0514%	0,0125%	-0,0287%	-0,0458%
p-value (RC)	0,992	0,877	0,870	0,161	0,220	0,252	0,326	0,424	0,875	0,164	0,000	0,402	0,989	0,511
Annualized Volatility	0,0167%	0,0945%	0,3481%	0,5422%	0,9049%	0,0281%	0,1100%	0,2927%	0,4432%	0,6876%	0,2333%	0,0610%	0,0112%	0,2683%
Annualized Sharpe Ratio	-2,3769	-1,0614	-1,1796	1,1414	0,7212	0,6541	0,5166	0,1736	-1,2420	1,0610	0,2201	0,2048	-2,5657	-0,1708

CSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0574%	0,0005%	-0,3970%	0,6048%	3,1564%	-0,0183%	0,1293%	-0,1313%	-0,6121%	0,9905%	0,0000%	0,0323%	-0,0342%	0,0720%
p-value (RC)	0,991	0,520	0,876	0,253	0,015	0,582	0,031	0,666	0,823	0,186	1,000	0,404	0,968	0,277
Annualized Volatility	0,0211%	0,0563%	0,3452%	0,7333%	1,3026%	0,0605%	0,0646%	0,2412%	0,5895%	1,0942%	0,0000%	0,1230%	0,0169%	0,1164%
Annualized Sharpe Ratio	-2,7159	0,0092	-1,1499	0,8248	2,4231	-0,3026	2,0013	-0,5443	-1,0383	0,9052	0,0000	0,2627	-2,0211	0,6191

TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0422%	0,0969%	-0,5487%	-1,2495%	-1,5158%	0,0247%	0,0598%	-0,0637%	-1,1356%	-2,5200%	0,0013%	-0,0591%	-0,0208%	0,0327%
p-value (RC)	0,978	0,145	0,917	0,987	0,947	0,209	0,323	0,566	0,986	0,999	0,065	0,801	0,217	0,556
Annualized Volatility	0,0167%	0,0945%	0,3479%	0,5370%	0,9001%	0,0281%	0,1101%	0,2927%	0,4385%	0,8896%	0,0173%	0,0609%	0,0113%	0,2683%
Annualized Sharpe Ratio	-2,5283	1,0256	-1,5771	-2,3270	-1,6840	0,8817	0,5436	-0,2176	-2,5894	-2,8327	0,0754	-0,9701	-1,8384	0,1219

CSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1546%	0,0147%	0,0000%	-0,0995%	-0,0861%	-0,0258%	0,0325%	0,0000%	0,0000%	-0,0228%	0,1161%	-0,0088%	0,0019%	0,0000%
p-value (RC)	0,977	0,431	1,000	0,908	0,947	0,465	0,272	1,000	1,000	0,933	0,082	0,834	0,473	1,000
Annualized Volatility	0,0649%	0,0443%	0,0000%	0,0594%	0,0533%	0,0934%	0,0403%	0,0000%	0,0000%	0,0137%	0,0696%	0,0079%	0,0231%	0,0000%
Annualized Sharpe Ratio	-2,3824	0,3310	0,0000	-1,6745	-1,6175	-0,2766	0,8063	0,0000	0,0000	-1,6707	1,6686	-1,1157	0,0822	0,0000

B&H	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0422%	-0,0969%	-0,7218%	-1,2495%	-1,5158%	-0,0247%	-0,2261%	-0,7051%	-1,1356%	-2,5200%	0,0312%	-0,0591%	-0,0095%	-0,3901%
Annualized Volatility	0,0167%	0,0945%	0,3458%	0,5370%	0,9001%	0,0281%	0,1092%	0,2894%	0,4385%	0,8896%	0,0173%	0,0609%	0,0113%	0,2670%
Annualized Sharpe Ratio	2,5292	-1,0255	-2,0871	-2,3270	-1,6840	-0,8818	-2,0703	-2,4367	-2,5894	-2,8327	1,8049	-0,9701	-0,8443	-1,4609

Table 15: Results: Investment Style Portfolios - Inverted In-Sample (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0378%	-0,0314%	-0,2341%	-0,3053%	-0,3529%	-0,0402%	0,0673%	0,0147%	-0,3199%	-0,3599%	0,0083%	0,0113%	-0,0036%	-0,1243%
p-value (RC)	1,000	0	0,548	0,753	0,609	1,000	0,000	0,684	0,243	0,026	0,117	0,049	0,919	0,656
Annualized Volatility	0,0443%	0,1025%	0,2928%	0,4599%	0,7831%	0,0315%	0,0932%	0,2568%	0,4321%	0,8838%	0,0456%	0,0802%	0,0145%	0,2181%
Annualized Sharpe Ratio	-0,8526	-0,3064	-0,7996	-0,6637	-0,4506	-1,2775	0,7227	0,0574	-0,7403	-0,4072	0,1818	0,1404	-0,2448	-0,5699

1. CSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0634%	-0,1261%	-0,3430%	-0,4994%	-0,5311%	-0,0765%	-0,0634%	-0,2743%	0,2677%	0,2307%	0,0145%	0,3576%	0,0024%	-0,0158%
p-value (RC)	1,000	0,003	0,318	0,515	0,522	1,000	0,000	0,627	0,782	0,024	1,000	0,025	0,376	0,386
Annualized Volatility	0,0903%	0,1311%	0,4097%	0,6938%	0,9866%	0,0616%	0,1278%	0,3507%	1,7934%	1,2279%	0,0875%	0,4493%	0,0215%	0,0556%
Annualized Sharpe Ratio	-0,7022	-0,9618	-0,8371	-0,7198	-0,5383	-1,2420	-0,4965	-0,7821	0,1493	0,1879	0,1663	0,7959	0,1106	-0,2843

2. CSC	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1403%	-0,0665%	-0,4165%	0,0033%	0,0000%	-0,1422%	0,5826%	0,1593%	0,0153%	0,0000%	0,0000%	0,0251%	0,0031%	0,0000%
p-value (RC)	1,000	1,000	0,610	0,391	0,460	1,000	0,000	0,000	0,000	0,660	1,000	0,000	0,827	1,000
Annualized Volatility	0,2409%	0,1357%	0,5622%	0,0118%	0,0000%	0,1382%	0,5414%	0,3232%	0,1812%	0,0000%	0,0000%	0,0286%	0,0079%	0,0000%
Annualized Sharpe Ratio	-0,5824	-0,4898	-0,7409	0,2772	0,0000	-1,0290	1,0761	0,4928	0,0846	0,0000	0,0000	0,8784	0,3934	0,0000

TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0554%	-0,0961%	-0,1545%	-0,1827%	-0,2716%	0,0803%	-0,0106%	-0,2079%	-0,4245%	0,8063%	-0,0119%	-0,0100%	0,0093%	0,0651%
p-value (RC)	0,000	0,965	0,740	0,981	0,991	0,000	0,954	0,973	0,903	0,059	0,388	0,532	0,014	0,230
Annualized Volatility	0,0442%	0,1023%	0,2930%	0,4668%	0,7833%	0,0312%	0,0933%	0,2564%	0,4318%	0,8918%	0,0459%	0,0802%	0,0145%	0,2182%
Annualized Sharpe Ratio	1,2529	-0,9394	-0,5273	-0,3914	-0,3467	2,5768	-0,1133	-0,8106	-0,9831	0,9041	-0,2595	-0,1244	0,6421	0,2983

CSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0570%	-0,0241%	-0,2466%	-0,4869%	-0,5701%	0,1786%	-0,0100%	-0,1474%	-0,2521%	0,9660%	0,0255%	-0,0637%	0,0096%	0,0427%
p-value (RC)	0,000	0,984	0,982	0,989	0,952	0,000	1,000	1,000	1,000	0,004	0,356	0,538	0,507	0,000
Annualized Volatility	0,1019%	0,0582%	0,2780%	0,5703%	1,1869%	0,0852%	0,0482%	0,1510%	0,3748%	0,9957%	0,1648%	0,1680%	0,0272%	0,1212%
Annualized Sharpe Ratio	0,5589	-0,4132	-0,8869	-0,8538	-0,4803	2,0953	-0,2072	-0,9759	-0,6726	0,9702	0,1550	-0,3793	0,3540	0,3522

TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0075%	0,0589%	-0,0744%	-0,2234%	-0,3529%	-0,0218%	-0,0228%	-0,1568%	-0,3616%	-0,5423%	0,0088%	-0,0293%	0,0012%	-0,0795%
p-value (RC)	0,323	0,154	0,413	0,578	0,599	1,000	1,000	1,000	0,381	0,042	0,007	0,296	0,546	0,921
Annualized Volatility	0,0444%	0,1024%	0,2931%	0,4668%	0,7831%	0,0315%	0,0933%	0,2566%	0,4320%	0,8834%	0,0456%	0,0727%	0,0145%	0,2182%
Annualized Sharpe Ratio	0,1684	0,5750	-0,2538	-0,4786	-0,4506	-0,6913	-0,2448	-0,6111	-0,8371	-0,6138	0,1926	-0,4027	0,0822	-0,3643

CSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0780%	0,0757%	0,9608%	-0,0082%	0,0143%	-0,0235%	0,0259%	0,0075%	0,0413%	-0,0201%	0,0174%	-0,0082%	0,0193%	0,1035%
p-value (RC)	0,000	0,006	1,000	0,688	0,730	1,000	0,000	0,827	1,000	0,990	0,008	0,000	0,643	0,929
Annualized Volatility	0,1070%	0,1900%	1,4825%	0,1031%	0,2178%	0,1947%	0,0579%	0,0135%	0,1024%	0,2301%	0,1358%	0,0483%	0,0519%	0,2915%
Annualized Sharpe Ratio	0,7290	0,3982	0,6481	-0,0796	0,0657	-0,1209	0,4470	0,5599	0,4038	-0,0873	0,1284	-0,1704	0,3729	0,3549

B&H	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0378%	-0,0835%	-0,2140%	-0,2902%	-0,3529%	-0,0400%	-0,0858%	-0,2638%	-0,4282%	-0,6779%	-0,0306%	-0,0411%	-0,0041%	-0,1243%
Annualized Volatility	0,0443%	0,1024%	0,2929%	0,4666%	0,7831%	0,0315%	0,0931%	0,2562%	0,4317%	0,8831%	0,0726%	0,0802%	0,0145%	0,2181%
Annualized Sharpe Ratio	-0,8526	-0,8159	-0,7308	-0,6219	-0,4506	-1,2712	-0,9219	-1,0296	-0,9919	-0,7677	-0,4218	-0,5129	-0,2855	-0,5699

Table 16: Results: Investment Style Portfolios - Inverted Out-of-Sample (Bloomberg L.P. 2017, own graph)

TSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0647%	0,0256%	-0,0478%	0,0058%	-0,0413%	-0,0147%	0,0900%	-0,0329%	-0,1523%	-0,2347%	-0,0023%	-0,0128%	-0,2113%
p-value (RC)	1,000	0,952	0,978	0,793	0,692	1,000	0,786	0,814	0,739	0,672	0,698	0,999	0,990
Annualized Volatility	0,0618%	0,1386%	0,3259%	0,4809%	0,7350%	0,0345%	0,1092%	0,2538%	0,3917%	0,6802%	0,0848%	0,0138%	0,3220%
Annualized Sharpe Ratio	-1,0465	0,1849	-0,1468	0,0120	-0,0562	-0,4275	0,8246	-0,1298	-0,3888	-0,3450	-0,0274	-0,9318	-0,6563

1. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,1503%	0,2803%	-0,0029%	-0,0809%	0,4029%	-0,0360%	0,2550%	0,0959%	-0,1336%	-0,1983%	-0,0311%	-0,0140%	-0,1023%
p-value (RC)	0,998	0	0,021	0,559	0,842	1	0,003	0,073	0,093	0,446	0,628	0,012	0,015
Annualized Volatility	0,1308%	0,2930%	0,5150%	0,7268%	1,2344%	0,0741%	0,4806%	0,4915%	0,2978%	0,4174%	0,1105%	0,0134%	0,1703%
Annualized Sharpe Ratio	-1,1492	0,9566	-0,0057	-0,1113	0,3264	-0,4860	0,5305	0,1950	-0,4487	-0,4752	-0,2811	-1,0487	-0,6008

2. CSC	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,2964%	0,3991%	-0,0080%	0,5470%	0,3963%	-0,1228%	0,3078%	-0,0023%	-0,0004%	0,0000%	-0,0110%	-0,0018%	0,0000%
p-value (RC)	0,986	0	0	0	0	1	0,088	0	1	1	0,591	1	1
Annualized Volatility	0,3490%	0,3924%	0,6444%	0,8990%	1,0399%	0,2147%	0,2907%	0,0347%	0,0010%	0,0000%	0,0173%	0,0033%	0,0000%
Annualized Sharpe Ratio	-0,8493	1,0171	-0,0124	0,6084	0,3811	-0,5722	1,0590	-0,0660	-0,3758	0,0000	-0,6381	-0,5546	0,0000

TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,1135%	-0,0557%	-0,1255%	-0,2180%	-0,3031%	0,0730%	0,0101%	-0,0083%	0,1607%	-0,5117%	-0,0866%	0,0129%	-0,1612%
p-value (RC)	0,395	0,905	0,797	0,538	0,576	0	0,664	0,678	0,193	0,625	0,824	0,035	0,763
Annualized Volatility	0,0615%	0,1385%	0,3258%	0,4807%	0,7347%	0,0342%	0,1093%	0,2538%	0,3917%	0,6139%	0,0846%	0,0138%	0,3221%
Annualized Sharpe Ratio	1,8451	-0,4018	-0,3853	-0,4535	-0,4126	2,1380	0,0928	-0,0328	0,4104	-0,8335	-1,0234	0,9363	-0,5004

CSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,2926%	-0,0569%	-0,3375%	-0,4683%	-0,3326%	0,2342%	-0,0534%	-0,0449%	0,3272%	-0,3814%	-0,1117%	0,0071%	-0,0271%
p-value (RC)	0,052	0,953	0,881	0,78	0,878	0	0,236	0,122	0,008	0,614	0,514	0,152	0,243
Annualized Volatility	0,1626%	0,1496%	0,4216%	0,6926%	1,1959%	0,0989%	0,1180%	0,3073%	0,5546%	0,9874%	0,1744%	0,0158%	0,1805%
Annualized Sharpe Ratio	1,7997	-0,3804	-0,8006	-0,6761	-0,2781	2,3682	-0,4523	-0,1462	0,5900	-0,3863	-0,6405	0,4496	-0,1502

TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0525%	-0,0999%	-0,1713%	-0,2248%	-0,2247%	-0,0147%	-0,0565%	-0,1348%	-0,1489%	-0,2347%	-0,0023%	-0,0055%	0,2568%
p-value (RC)	0,999	0,995	0,99	0,961	0,883	0,999	0,993	0,972	0,87	0,69	0,654	0,188	0,999
Annualized Volatility	0,0618%	0,1384%	0,3257%	0,4806%	0,7348%	0,0345%	0,1093%	0,2537%	0,3917%	0,6802%	0,0848%	0,0138%	0,3219%
Annualized Sharpe Ratio	-0,8487	-0,7220	-0,5260	-0,4677	-0,3058	-0,4275	-0,5170	-0,5314	-0,3802	-0,3450	-0,0274	-0,3957	0,7979

CSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0942%	-0,0156%	0,5814%	0,2137%	0,0199%	-0,0117%	0,0000%	0,0000%	0,0498%	-0,0752%	-0,0450%	0,0471%	-2,0845%
p-value (RC)	1	1	0	0,578	0,815	1	1	1	0	0,289	0,674	0,05	1
Annualized Volatility	0,2830%	0,0199%	1,4720%	0,6955%	1,1241%	0,0267%	0,0000%	0,0000%	0,0864%	0,8480%	0,2691%	0,0989%	4,5157%
Annualized Sharpe Ratio	-0,3327	-0,7841	0,3950	0,3073	0,0177	-0,4381	0,0000	0,0000	0,5766	-0,0887	-0,1670	0,4761	-0,4616

B&H	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0647%	-0,0999%	-0,1713%	-0,2248%	-0,2247%	-0,0147%	-0,0565%	-0,1348%	-0,1489%	-0,2347%	-0,0023%	-0,0127%	-0,2113%
Annualized Volatility	0,0618%	0,1384%	0,3257%	0,4806%	0,7348%	0,0345%	0,1093%	0,2537%	0,3917%	0,6802%	0,0848%	0,0138%	0,3220%
Annualized Sharpe Ratio	-1,0465	-0,7220	-0,5260	-0,4677	-0,3058	-0,4275	-0,5170	-0,5314	-0,3802	-0,3450	-0,0274	-0,9238	-0,6563

Table 17: Results: Combined Investment Style Portfolios - In-Sample (Bloomberg L.P. 2017, own graph)

TSC & TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0715%	0,1243%	0,2075%	0,2588%	0,3699%	-0,0011%	0,0306%	0,0973%	0,1588%	0,2340%	-0,0022%	0,0142%	0,1700%
p-value (RC)	0,858	0	0,071	0,076	0,185	0,488	0	0,156	0,03	0,056	0,232	0,68	0,84
Annualized Volatility	0,0564%	0,1119%	0,2812%	0,4167%	0,6497%	0,0298%	0,0768%	0,2222%	0,3407%	0,6195%	0,0756%	0,0126%	0,2656%
Annualized Sharpe Ratio	1,2686	1,1111	0,7379	0,6211	0,5694	-0,0371	0,3989	0,4381	0,4662	0,3777	-0,0285	1,1269	0,6402

TSC & TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0457%	-0,0061%	-0,0211%	-0,0412%	-0,1305%	0,0100%	0,0179%	0,0513%	0,0367%	0,1826%	-0,0272%	0,0047%	0,1188%
p-value (RC)	0,713	0,372	0,365	0,684	0,431	0,395	0,246	0,074	0,078	0,273	0,243	0,594	0,917
Annualized Volatility	0,0439%	0,0966%	0,2238%	0,3322%	0,5114%	0,0223%	0,0702%	0,1723%	0,2602%	0,4470%	0,0551%	0,0090%	0,1834%
Annualized Sharpe Ratio	1,0399	-0,0631	-0,0945	-0,1240	-0,2552	0,4505	0,2552	0,2976	0,1409	0,4086	-0,4934	0,5257	0,6480

TSV & TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0526%	0,0276%	-0,0058%	-0,0023%	-0,1867%	0,0100%	0,0289%	0,0559%	0,0182%	0,1817%	-0,0272%	0,0082%	0,1188%
p-value (RC)	0,687	0,586	0,397	0,744	0,249	0,372	0,137	0,077	0,248	0,302	0,241	0,166	0,94
Annualized Volatility	0,0443%	0,0950%	0,2278%	0,3303%	0,5097%	0,0223%	0,0731%	0,1785%	0,2600%	0,4508%	0,0551%	0,0096%	0,1834%
Annualized Sharpe Ratio	1,1886	0,2910	-0,0255	-0,0071	-0,3664	0,4505	0,3952	0,3133	0,0699	0,4030	-0,4934	0,8547	0,6480

TSC, TSM & TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0525%	0,0504%	0,0201%	-0,0302%	-0,2174%	0,0100%	0,0107%	0,0540%	0,0124%	0,2124%	-0,0272%	0,0030%	0,1188%
p-value (RC)	0,666	0,053	0,128	0,555	0,351	0,394	0	0,267	0,14	0,277	0,243	0,442	0,917
Annualized Volatility	0,0390%	0,0772%	0,1998%	0,2996%	0,4735%	0,0223%	0,0549%	0,1625%	0,2520%	0,4446%	0,0551%	0,0068%	0,1834%
Annualized Sharpe Ratio	1,3441	0,6531	0,1005	-0,1008	-0,4592	0,4505	0,1946	0,3322	0,0491	0,4778	-0,4934	0,4492	0,6480

Table 18: Results: Combined Investment Style Portfolios - Out-of-Sample (Bloomberg L.P. 2017, own graph)

TSC & TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0039%	0,0355%	0,1750%	0,2353%	0,3819%	0,0002%	-0,0233%	0,1542%	0,4109%	0,8717%	-0,0021%	0,0317%	0,0007%	0,1062%
p-value (RC)	0,000	0,658	0,985	0,890	0,759	0,308	0,988	0,882	0,435	0,457	0,757	0,682	0,000	0,665
Annualized Volatility	0,0090%	0,0342%	0,1983%	0,3655%	0,7283%	0,0127%	0,0530%	0,1577%	0,3486%	0,8595%	0,0398%	0,0603%	0,0058%	0,1299%
Annualized Sharpe Ratio	0,4343	1,0393	0,8823	0,6436	0,5244	0,0135	-0,4397	0,9780	1,1788	1,0142	-0,0519	0,5254	0,1290	0,8180

TSC & TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0160%	0,0196%	0,0206%	0,1240%	0,2088%	0,0070%	-0,0185%	0,0992%	0,1383%	0,2379%	0,0004%	0,0151%	0,0035%	0,0586%
p-value (RC)	0,982	0,773	0,779	0,274	0,274	0,033	0,404	0,762	0,593	0,532	0,622	0,894	0,939	0,583
Annualized Volatility	0,0121%	0,0406%	0,1526%	0,2564%	0,5281%	0,0125%	0,0410%	0,1492%	0,2984%	0,6685%	0,0280%	0,0468%	0,0050%	0,1139%
Annualized Sharpe Ratio	1,3241	0,4828	0,1349	0,4834	0,3954	0,5570	-0,4506	0,6649	0,4635	0,3559	0,0144	0,3233	0,7062	0,5146

TSV & TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0045%	0,0099%	0,0459%	0,1240%	0,2088%	-0,0011%	-0,0312%	-0,0136%	0,1130%	0,4570%	0,0004%	0,0218%	0,0018%	0,0015%
p-value (RC)	0,461	0,188	0,861	0,296	0,273	0,703	0,795	0,926	0,640	0,362	0,116	0,822	0,281	0,630
Annualized Volatility	0,0166%	0,0387%	0,1541%	0,2564%	0,5281%	0,0135%	0,0402%	0,1470%	0,3053%	0,6822%	0,0280%	0,0494%	0,0051%	0,1123%
Annualized Sharpe Ratio	0,2730	0,2549	0,2982	0,4834	0,3954	-0,0820	-0,7762	-0,0928	0,3702	0,6698	0,0144	0,4414	0,3436	0,0135

TSC, TSM & TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0038%	0,0222%	0,0217%	0,1240%	0,2088%	0,0012%	-0,0215%	0,0371%	0,1730%	0,3034%	0,0004%	0,0088%	0,0019%	0,0285%
p-value (RC)	0,000	0,000	0,915	0,268	0,276	0,368	0,990	0,904	0,530	0,462	0,114	0,932	0,949	0,729
Annualized Volatility	0,0075%	0,0232%	0,1392%	0,2564%	0,5281%	0,0079%	0,0329%	0,1102%	0,2562%	0,6251%	0,0280%	0,0425%	0,0034%	0,0914%
Annualized Sharpe Ratio	0,5027	0,9550	0,1558	0,4834	0,3954	0,1551	-0,6533	0,3369	0,6755	0,4853	0,0144	0,2082	0,5565	0,3120

Table 19: Results: Combined Investment Style Portfolios - Inverted In-Sample (Bloomberg L.P. 2017, own graph)

TSC & TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0149%	0,0140%	-0,1538%	-0,2440%	-0,3529%	-0,0310%	0,0230%	-0,0704%	-0,3396%	-0,4522%	0,0083%	-0,0145%	-0,0011%	-0,1019%
p-value (RC)	1,000	0,147	0,489	0,685	0,593	1,000	0,704	0,985	1,000	0,028	0,119	0,133	0,932	0,875
Annualized Volatility	0,0405%	0,0650%	0,2672%	0,4512%	0,7831%	0,0295%	0,0557%	0,2048%	0,3992%	0,8453%	0,0456%	0,0735%	0,0116%	0,2162%
Annualized Sharpe Ratio	-0,3686	0,2160	-0,5754	-0,5409	-0,4506	-1,0508	0,4130	-0,3439	-0,8507	-0,5350	0,1818	-0,1972	-0,0945	-0,4712

TSC & TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0071%	-0,0653%	-0,2025%	-0,2630%	-0,3239%	0,0192%	0,0281%	-0,1007%	-0,3871%	-0,3068%	-0,0061%	0,0020%	0,0028%	-0,0304%
p-value (RC)	0,002	0,882	0,743	0,986	0,980	0,000	0,000	0,980	0,681	0,151	0,311	0,140	0,286	0,328
Annualized Volatility	0,0338%	0,0710%	0,2008%	0,3228%	0,5461%	0,0200%	0,0720%	0,1836%	0,3130%	0,6116%	0,0330%	0,0550%	0,0096%	0,1591%
Annualized Sharpe Ratio	0,2108	-0,9198	-1,0084	-0,8149	-0,5930	0,9594	0,3897	-0,5483	-1,2366	-0,5017	-0,1864	0,0357	0,2904	-0,1912

TSV & TSM	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0299%	-0,0175%	-0,1171%	-0,2018%	-0,3239%	0,0284%	-0,0180%	-0,1897%	-0,4093%	-0,4051%	-0,0061%	-0,0250%	0,0053%	-0,0070%
p-value (RC)	0,000	0,686	0,640	0,957	0,989	0,000	1,000	1,000	0,743	0,178	0,320	0,351	0,227	0,662
Annualized Volatility	0,0337%	0,0621%	0,2045%	0,3238%	0,5461%	0,0204%	0,0600%	0,1763%	0,3127%	0,6281%	0,0330%	0,0543%	0,0098%	0,1598%
Annualized Sharpe Ratio	0,8871	-0,2821	-0,5726	-0,6234	-0,5930	1,3970	-0,2998	-1,0759	-1,3090	-0,6450	-0,1864	-0,4611	0,5389	-0,0441

TSC, TSM & TSV	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0075%	0,0022%	-0,1814%	-0,2241%	-0,3239%	0,0134%	-0,0002%	-0,1009%	-0,4092%	-0,3553%	-0,0061%	-0,0155%	0,0031%	-0,0306%
p-value (RC)	0,000	0,000	0,752	0,970	0,992	0,000	0,960	0,987	0,688	0,675	0,316	0,275	0,060	1,000
Annualized Volatility	0,0312%	0,0361%	0,1839%	0,3170%	0,5461%	0,0186%	0,0399%	0,1429%	0,2901%	0,5925%	0,0330%	0,0497%	0,0074%	0,1581%
Annualized Sharpe Ratio	0,2418	0,0613	-0,9868	-0,7071	-0,5930	0,7197	-0,0042	-0,7061	-1,4105	-0,5997	-0,1864	-0,3111	0,4188	-0,1938

Table 20: Results: Combined Investment Style Portfolios - Inverted Out-of-Sample (Bloomberg L.P. 2017, own graph)

TSC & TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0585%	-0,0382%	-0,1104%	-0,1081%	-0,1332%	-0,0147%	0,0164%	-0,0843%	-0,1518%	-0,2347%	-0,0023%	-0,0091%	-0,2341%
p-value (RC)	0,998	0,991	0,989	0,896	0,808	1	0,969	0,912	0,816	0,66	0,649	1	0,997
Annualized Volatility	0,0589%	0,1265%	0,3094%	0,4525%	0,7000%	0,0345%	0,0912%	0,2428%	0,3884%	0,6802%	0,0848%	0,0090%	0,3074%
Annualized Sharpe Ratio	-0,9944	-0,3021	-0,3567	-0,2388	-0,1903	-0,4275	0,1795	-0,3473	-0,3908	-0,3450	-0,0274	-1,0137	-0,7615

TSC & TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0175%	-0,0131%	-0,0922%	-0,1080%	-0,1706%	0,0263%	0,0500%	-0,0291%	-0,0032%	-0,2292%	-0,0462%	-0,0002%	-0,1950%
p-value (RC)	0,982	0,989	0,975	0,739	0,672	0,245	0,825	0,835	0,466	0,136	0,833	0,712	0,994
Annualized Volatility	0,0442%	0,0953%	0,2247%	0,3347%	0,5147%	0,0233%	0,0782%	0,1774%	0,2740%	0,4740%	0,0573%	0,0095%	0,2228%
Annualized Sharpe Ratio	0,3949	-0,1372	-0,4101	-0,3226	-0,3315	1,1295	0,6397	-0,1639	-0,0116	-0,4834	-0,8068	-0,0233	-0,8754

TSV & TSM	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0238%	-0,0800%	-0,1567%	-0,2288%	-0,2716%	0,0263%	-0,0276%	-0,0825%	-0,0024%	-0,2292%	-0,0462%	0,0036%	-0,2193%
p-value (RC)	0,981	0,995	0,984	0,982	0,824	0,252	0,985	0,948	0,535	0,147	0,853	0,009	0,994
Annualized Volatility	0,0439%	0,0945%	0,2241%	0,3304%	0,5087%	0,0233%	0,0756%	0,1790%	0,2745%	0,4740%	0,0573%	0,0100%	0,2181%
Annualized Sharpe Ratio	0,5434	-0,8469	-0,6992	-0,6925	-0,5339	1,1295	-0,3657	-0,4608	-0,0088	-0,4834	-0,8068	0,3647	-1,0053

TSC, TSM & TSV	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0233%	-0,0278%	-0,0832%	-0,1088%	-0,1889%	0,0263%	0,0023%	-0,0491%	0,0001%	-0,2292%	-0,0462%	-0,0026%	-0,2124%
p-value (RC)	0,985	0,983	0,951	0,748	0,714	0,269	0,995	1	0,491	0,106	0,827	1	0,997
Annualized Volatility	0,0420%	0,0861%	0,2125%	0,3121%	0,4866%	0,0233%	0,0640%	0,1704%	0,2719%	0,4740%	0,0573%	0,0064%	0,2098%
Annualized Sharpe Ratio	0,5553	-0,3231	-0,3913	-0,3487	-0,3882	1,1295	0,0364	-0,2878	0,0005	-0,4834	-0,8068	-0,4126	-1,0122

Table 21: Ranking of Futures' Risk-adjusted Performance - In-Sample

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia	Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	10yrs	3m	10yrs
TSC	3	2	3	3	1	6	3	3	2	2	3	5	2
1. CSC	2	5	4	4	2	4	8	6	5	5	5	2	1
2. CSC	5	7	6	6	6	3	7	7	8	6	6	3	6
TSM	7	8	7	8	8	1	5	4	7	7	8	6	5
CSM	6	6	8	7	7	2	4	8	6	8	7	8	8
TSV	1	1	1	1	3	6	1	2	3	4	3	1	2
CSV	8	3	5	5	5	5	6	5	1	1	1	7	6
B&H	4	4	1	2	3	8	1	1	4	3	2	4	4

Table 22: Ranking of Single Investment Style Portfolios - In-Sample (Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	1,6950%	1,5957%	0,1003%	-1,4486%	-2,1916%	1,7623%	2,3906%	1,6285%
Ranking	3	4	5	6	7	2	1	
Annualized Volatility	2,3811%	2,6997%	2,1596%	1,8915%	2,0198%	2,6547%	2,5584%	2,6637%
Annualized Sharpe Ratio	0,7118	0,5910	0,0464	-0,7659	-1,0851	0,6639	0,9344	0,6114
Ranking	2	4	5	6	7	3	1	

Table 23: Ranking of Futures' Risk-adjusted Performance - Out-of-Sample

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia		Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	3m	10yrs	3m	10yrs
TSC	3	1	2	1	1	2	4	1	3	4	7	3	3	1
1. CSC	4	3	4	4	4	4	2	3	1	5	8	7	5	3
2. CSC	5	5	5	5	8	6	6	6	6	7	3	5	4	4
TSM	1	6	7	7	7	3	5	7	8	8	1	6	1	5
CSM	6	7	8	8	6	5	3	5	7	6	4	8	6	8
TSV	7	4	1	3	1	7	8	4	4	1	5	1	7	6
CSV	8	8	6	6	5	8	7	8	5	2	2	4	8	7
B&H	2	2	3	2	1	1	1	2	2	3	6	1	2	2

Table 24: Ranking of Single Investment Style Portfolios - Out-of-Sample (Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	2,3636%	1,7807%	-0,2041%	-0,3439%	-0,2524%	2,2859%	1,3837%	2,3938%
Ranking	1	3	5	7	6	2	4	
Annualized Volatility	2,5050%	2,4373%	0,8263%	1,9279%	1,7532%	2,0278%	4,5325%	2,6416%
Annualized Sharpe Ratio	0,9436	0,7306	-0,2470	-0,1784	-0,1440	1,1273	0,3053	0,9062
Ranking	2	3	7	6	5	1	4	

Table 25: Ranking of Futures' Risk-adjusted Performance - 16.06.2003-02.09.2003

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia	Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	10yrs	3m	10yrs
TSC	6	7	8	8	7	7	5	5	8	5	3	6	5
1. CSC	5	3	5	5	4	4	6	8	5	8	7	8	8
2. CSC	8	2	3	1	1	5	2	1	1	1	8	4	3
TSM	3	6	1	4	3	2	4	4	3	2	6	2	1
CSM	4	4	4	2	5	1	1	3	2	3	1	7	2
TSV	1	5	7	7	7	7	7	6	7	5	3	3	5
CSV	2	1	2	3	1	3	3	1	4	4	2	1	3
B&H	7	8	6	6	6	6	8	7	6	7	5	5	7

Table 26: Ranking of Single Investment Style Portfolios - 16.06.2003-02.09.2003

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-18,5542%	-15,0123%	-2,2376%	-2,9129%	-6,1062%	-17,9183%	2,1934%	-19,0019%
Ranking	7	5	2	3	4	6	1	
Annualized Volatility	4,2346%	4,6705%	1,6034%	2,7448%	2,5693%	4,0514%	0,9271%	4,2154%
Annualized Sharpe Ratio	-4,3816	-3,2143	-1,3956	-1,0612	-2,3766	-4,4227	2,3660	-4,507712309
Ranking	6	5	3	2	4	7	1	

Table 27: Ranking of Futures' Risk-adjusted Performance - 17.03.2004-14.06.2004

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia	Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	10yrs	3m	10yrs
TSC	5	8	5	6	6	4	6	6	6	5	2	6	5
1. CSC	7	7	8	8	5	7	1	1	3	8	6	8	8
2. CSC	8	4	7	2	2	3	2	2	1	1	1	5	3
TSM	4	2	2	4	3	8	5	7	8	3	8	1	2
CSM	1	5	3	1	1	2	4	8	7	2	7	4	1
TSV	3	3	4	5	6	4	7	5	5	5	2	3	5
CSV	2	1	1	2	4	1	2	2	2	4	5	2	3
B&H	6	6	6	7	6	6	8	4	4	5	4	7	7

Table 28: Ranking of Single Investment Style Portfolios - 17.03.2004-14.06.2004

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-11,7566%	-9,6426%	-2,8899%	-6,7221%	-3,8301%	-10,8050%	1,6454%	-11,4087%
Ranking	7	5	2	4	3	6	1	
Annualized Volatility	2,7670%	2,5056%	0,5977%	1,9628%	2,1063%	2,5970%	0,3305%	2,7251%
Annualized Sharpe Ratio	-4,2488	-3,8484	-4,8352	-3,4247	-1,8183	-4,1606	4,9791	-4,1865
Ranking	6	4	7	3	2	5	1	

Table 29: Ranking of Futures' Risk-adjusted Performance - 28.06.2005-14.11.2005

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia	Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	10yrs	3m	10yrs
TSC	5	6	7	5	5	5	6	7	7	3	5	7	4
1. CSC	8	5	4	8	8	8	2	5	8	6	3	8	7
2. CSC	4	4	5	2	1	4	1	3	2	1	2	3	1
TSM	2	2	1	1	2	1	4	1	4	8	8	4	8
CSM	1	1	3	4	3	3	5	2	3	7	7	5	3
TSV	7	7	6	6	6	5	7	6	5	3	5	2	4
CSV	3	3	2	2	4	2	3	3	1	2	1	1	1
B&H	6	8	8	7	7	7	8	8	6	5	4	6	6

Table 30: Ranking of Single Investment Style Portfolios - 28.06.2005-14.11.2005

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-5,2417%	-5,3167%	-1,2744%	-1,4422%	-2,3671%	-5,2814%	0,2215%	-5,3384%
Ranking	5	7	2	3	4	6	1	
Annualized Volatility	2,0822%	2,0218%	0,5822%	1,4456%	1,4064%	2,0741%	0,7157%	2,0605%
Annualized Sharpe Ratio	-2,5174	-2,6296	-2,1888	-0,9977	-1,6832	-2,5464	0,3094	-2,5908
Ranking	5	7	4	2	3	6	1	

Table 31: Ranking of Futures' Risk-adjusted Performance - 01.06.2005-01.06.2006

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia	Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	10yrs	3m	10yrs
TSC	4	1	1	2	2	5	5	6	6	4	2	8	4
1. CSC	8	7	8	8	8	8	2	5	8	3	3	6	3
2. CSC	7	5	3	1	1	4	1	2	1	1	1	4	1
TSM	2	4	4	3	5	3	4	1	3	7	8	2	7
CSM	1	2	5	5	4	1	6	4	4	8	7	5	8
TSV	6	8	7	6	6	5	7	7	5	4	5	1	4
CSV	3	3	2	4	3	2	3	2	2	2	4	3	1
B&H	5	6	6	7	7	7	8	8	7	6	6	7	6

Table 32: Ranking of Single Investment Style Portfolios - 01.06.2005-01.06.2006

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-1,2426%	-3,4613%	3,9707%	-2,7712%	-3,9350%	-3,3941%	0,0494%	-3,4025%
Ranking	3	6	1	4	7	5	2	
Annualized Volatility	1,8561%	2,0123%	1,7659%	1,3603%	1,4299%	2,1134%	1,7142%	2,1045%
Annualized Sharpe Ratio	-0,6695	-1,7201	2,2485	-2,0372	-2,7519	-1,6059	0,0288	-1,6168
Ranking	3	5	1	6	7	4	2	

Table 33: Ranking of Futures' Risk-adjusted Performance - 5.11.2010-3.03.2011

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia		Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	3m	10yrs	3m	10yrs
TSC	4	6	8	6	6	7	6	7	7	6	3	7	4	7
1. CSC	1	8	6	8	8	6	7	8	5	5	7	1	5	8
2. CSC	2	4	5	3	3	5	1	2	1	3	1	4	2	3
TSM	5	7	3	1	2	2	5	1	4	1	5	3	8	5
CSM	8	3	2	2	1	4	2	5	3	2	8	2	7	1
TSV	7	1	4	7	5	1	4	4	6	7	6	5	6	2
CSV	6	2	1	4	4	3	3	2	1	4	4	8	1	3
B&H	3	5	7	5	7	8	8	6	7	7	2	5	3	6

Table 34: Ranking of Single Investment Style Portfolios - 5.11.2010-3.03.2011

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-8,5417%	-7,8276%	2,2230%	1,0153%	3,7355%	-6,9398%	-0,2325%	-8,5807%
Ranking	7	6	2	3	1	5	4	
Annualized Volatility	2,9575%	2,6439%	0,8869%	2,0581%	2,2035%	2,5103%	0,1644%	2,8171%
Annualized Sharpe Ratio	-2,8882	-2,9606	2,5065	0,4933	1,6953	-2,7645	-1,4149	-3,0459
Ranking	6	7	1	3	2	5	4	

Table 35: Ranking of Futures' Risk-adjusted Performance - Inverted In-Sample

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia		Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	3m	10yrs	3m	10yrs
TSC	7	3	6	6	4	8	2	3	5	6	2	3	7	8
1. CSC	6	8	7	7	8	6	7	5	2	3	3	2	5	5
2. CSC	5	5	5	1	2	5	1	2	3	4	6	1	2	4
TSM	1	7	3	3	3	1	4	6	7	2	7	4	1	3
CSM	3	4	8	8	7	2	5	7	4	1	4	6	4	2
TSV	4	1	2	4	4	4	6	4	6	7	1	7	6	6
CSV	2	2	1	2	1	3	3	1	1	5	5	5	3	1
B&H	8	6	4	5	6	7	8	8	8	8	8	8	8	7

Table 36: Ranking of Single Investment Style Portfolios - Inverted In-Sample

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-1,7076%	-1,1201%	0,0232%	-0,3533%	-0,5214%	-1,7884%	1,2838%	-2,6743%
Ranking	6	5	2	3	4	7	1	
Annualized Volatility	2,7613%	3,3534%	1,0352%	1,9915%	2,0614%	2,5513%	1,5531%	2,9024%
Annualized Sharpe Ratio	-0,6184	-0,3340	0,0224	-0,1774	-0,2529	-0,7010	0,8266	-0,9214
Ranking	6	5	2	3	4	7	1	

Table 37: Ranking of Futures' Risk-adjusted Performance - Inverted Out-of-Sample

(Bloomberg L.P., 2017, own graph)

	United States					European Union					Australia	Japan	
	3m	2yrs	5yrs	10yrs	30yrs	3m	2yrs	5yrs	10yrs	30yrs	10yrs	3m	10yrs
TSC	6	3	4	3	4	3	2	5	7	4	3	7	7
1. CSC	8	2	2	4	2	7	3	1	8	7	5	8	6
2. CSC	5	1	3	1	1	8	1	4	4	1	6	5	2
TSM	1	5	5	5	8	2	4	3	3	8	8	1	5
CSM	2	4	8	8	5	1	6	6	1	6	7	3	3
TSV	4	6	6	7	7	3	8	8	5	3	1	4	1
CSV	3	8	1	2	3	6	5	2	2	2	4	2	4
B&H	7	6	7	6	6	5	7	7	6	5	1	6	8

Table 38: Ranking of Single Investment Style Portfolios - Inverted Out-of-Sample

(Bloomberg L.P., 2017, own graph)

	Single Portfolios							
	TSC	1. CSC	2. CSC	TSM	CSM	TSV	CSV	B&H
Annualized Performance	-0,6935%	0,2845%	1,2074%	-1,0997%	-0,9527%	-1,1138%	-1,4141%	-1,6014%
Ranking	3	2	1	5	4	6	7	
Annualized Volatility	2,6560%	2,7719%	2,0649%	1,9035%	2,1085%	2,8059%	5,2088%	2,8226%
Annualized Sharpe Ratio	-0,2611	0,1026	0,5848	-0,5777	-0,4518	-0,3970	-0,2715	-0,5674
Ranking	3	2	1	7	6	5	4	

Table 39: Ranking of Combined Investment Style Portfolios - In-Sample (Bloomberg L.P., 2017, own graph)

	Combined Portfolios				
	TSC & TSV	TSC & TSM	TSV & TSM	All Three	B&H
Annualized Performance	1,7338%	0,2416%	0,2799%	0,2695%	1,6285%
Ranking	1	4	2	3	
Annualized Volatility	2,3739%	1,6507%	1,7397%	1,5798%	2,6637%
Annualized Sharpe Ratio	0,7304	0,1464	0,1609	0,1706	0,6114
Ranking	1	4	3	2	

Table 40: Ranking of Combined Investment Style Portfolios - Out-of-Sample

(Bloomberg L.P., 2017, own graph)

	Combined Portfolios				
	TSC & TSV	TSC & TSM	TSV & TSM	All Three	B&H
Annualized Performance	2,2757%	0,8721%	0,9412%	0,8848%	2,3938%
Ranking	1	4	2	3	
Annualized Volatility	2,1985%	1,6951%	1,5291%	1,5010%	2,6416%
Annualized Sharpe Ratio	1,0351	0,5145	0,6155	0,5894	0,9062
Ranking	1	4	2	3	

Table 41: Ranking of Combined Investment Style Portfolios - Inverted In-Sample

(Bloomberg L.P., 2017, own graph)

	Combined Portfolios				
	TSC & TSV	TSC & TSM	TSV & TSM	All Three	B&H
Annualized Performance	-1,7309%	-1,6267%	-1,6571%	-1,6209%	-2,6743%
Ranking	4	2	3	1	
Annualized Volatility	2,5754%	1,7953%	1,7211%	1,6630%	2,9024%
Annualized Sharpe Ratio	-0,6721	-0,9061	-0,9628	-0,9747	-0,9214
Ranking	1	2	3	4	

Table 42: Ranking of Combined Investment Style Portfolios - Inverted Out-of-Sample

(Bloomberg L.P., 2017, own graph)

	Combined Portfolios				
	TSC & TSV	TSC & TSM	TSV & TSM	All Three	B&H
Annualized Performance	-1,1632%	-0,7929%	-1,2906%	-0,8962%	-1,6014%
Ranking	3	1	4	2	
Annualized Volatility	2,6750%	1,7103%	1,7657%	1,6898%	2,8226%
Annualized Sharpe Ratio	-0,4348	-0,4636	-0,7310	-0,5303	-0,5674
Ranking	1	2	4	3	

Table 43: Ranking of All Investment Style Portfolios according to Risk-adjusted Performance

(Bloomberg L.P., 2017, own graph)

Ranking of All Investment Style Portfolios before Transaction Costs							
In-Sample		Out-of-Sample		Inverted In-Sample		Inverted Out-of-Sample	
CSV	0,9344	TSV	1,1273	CSV	0,8266	2. CSC	0,5848
TSC & TSV	0,7304	TSC & TSV	1,0351	2. CSC	0,0224	1. CSC	0,1026
TSC	0,7118	TSC	0,9436	TSM	-0,1774	TSC	-0,2611
TSV	0,6639	B&H	0,9062	CSM	-0,2529	CSV	-0,2715
B&H	0,6114	1. CSC	0,7306	1. CSC	-0,3340	TSV	-0,3970
1. CSC	0,5910	TSV & TSM	0,6155	TSC	-0,6184	TSC & TSV	-0,4348
TSC, TSM & TSV	0,1706	TSC, TSM & TSV	0,5894	TSC & TSV	-0,6721	CSM	-0,4518
TSV & TSM	0,1609	TSC & TSM	0,5145	TSV	-0,7010	TSC & TSM	-0,4636
TSC & TSM	0,1464	CSV	0,3053	TSC & TSM	-0,9061	TSC, TSM & TSV	-0,5303
2. CSC	0,0464	CSM	-0,1440	B&H	-0,9214	B&H	-0,5674
TSM	-0,7659	TSM	-0,1784	TSV & TSM	-0,9628	TSM	-0,5777
CSM	-1,0851	2. CSC	-0,2470	TSC, TSM & TSV	-0,9747	TSV & TSM	-0,7310

Table 44: Results: Outperforming Investment Style Portfolios after Transaction Costs - In-Sample (Bloomberg L.P., 2017, own graph)

TSC & TSV (0,01% cost per trade)	**United States**					**European Union**					**Australia**	**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06600%	0,01373%	0,15214%	0,19242%	0,3146%	-0,0011%	-0,0163%	0,0697%	0,1326%	0,2146%	-0,0022%	-0,0079%	0,1700%
Annualized Volatility	0,0564%	0,1117%	0,2811%	0,4166%	0,6496%	0,0298%	0,0768%	0,2222%	0,3407%	0,6195%	0,0756%	0,0126%	0,2656%
Annualized Sharpe Ratio	1,1707	0,1229	0,5412	0,4619	0,4842	-0,0371	-0,2124	0,3137	0,3891	0,3464	-0,0285	-0,6258	0,6402

TSV (0,01% cost per trade)	**United States**					**European Union**					**Australia**	**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,07290%	0,12355%	0,21929%	0,29442%	0,3133%	-0,0011%	0,0411%	0,1012%	0,1420%	0,2343%	-0,0022%	-0,0045%	0,1700%
Annualized Volatility	0,0633%	0,1374%	0,3180%	0,4618%	0,7034%	0,0298%	0,1007%	0,2410%	0,3526%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,1508	0,8992	0,6896	0,6376	0,4455	-0,0371	0,4079	0,4198	0,4028	0,3746	-0,0285	-0,2879	0,6402

TSC (0,01% cost per trade)	**United States**					**European Union**					**Australia**	**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06436%	0,01420%	0,13818%	0,15462%	0,3636%	-0,0011%	-0,0278%	0,0670%	0,1501%	0,2158%	-0,0022%	0,0107%	0,1700%
Annualized Volatility	0,0634%	0,1376%	0,3181%	0,4620%	0,7032%	0,0298%	0,1007%	0,2410%	0,3525%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,0150	0,1031	0,4343	0,3347	0,5171	-0,0371	-0,2755	0,2781	0,4258	0,3450	-0,0285	0,6917	0,6402

TSC & TSV (0,02% cost per trade)	**United States**					**European Union**					**Australia**	**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06048%	-0,09670%	0,09683%	0,12608%	0,2592%	-0,0011%	-0,0633%	0,0421%	0,1063%	0,1952%	-0,0022%	-0,0299%	0,1700%
Annualized Volatility	0,0564%	0,1118%	0,2811%	0,4166%	0,6496%	0,0298%	0,0769%	0,2222%	0,3407%	0,6195%	0,0756%	0,0127%	0,2656%
Annualized Sharpe Ratio	1,0728	-0,8648	0,3445	0,3027	0,3990	-0,0371	-0,8226	0,1893	0,3120	0,3152	-0,0285	-2,3570	0,6402

TSV (0,02% cost per trade)	**United States**					**European Union**					**Australia**	**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06737%	0,09315%	0,21929%	0,29442%	0,3133%	-0,0011%	0,0411%	0,1012%	0,1420%	0,2343%	-0,0022%	-0,0265%	0,1700%
Annualized Volatility	0,0633%	0,1374%	0,3180%	0,4618%	0,7034%	0,0298%	0,1007%	0,2410%	0,3526%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,0636	0,6780	0,6896	0,6376	0,4455	-0,0371	0,4079	0,4198	0,4028	0,3746	-0,0285	-1,7139	0,6402

TSC (0,02% cost per trade)	**United States**					**European Union**					**Australia**	**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06436%	-0,06584%	0,08291%	0,08829%	0,3082%	-0,0011%	-0,0747%	0,0394%	0,1238%	0,1964%	-0,0022%	0,0107%	0,1700%
Annualized Volatility	0,0634%	0,1376%	0,3181%	0,4620%	0,7032%	0,0298%	0,1007%	0,2410%	0,3525%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,0150	-0,4783	0,2606	0,1911	0,4383	-0,0371	-0,7413	0,1635	0,3513	0,3140	-0,0285	0,6917	0,6402

TSC & TSV (0,03% cost per trade)	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,05495%	-0,20703%	0,04155%	0,05977%	0,2039%	-0,0011%	-0,1102%	0,0144%	0,0800%	0,1759%	-0,0022%	-0,0520%	0,1700%
Annualized Volatility	0,0564%	0,1122%	0,2811%	0,4166%	0,6496%	0,0298%	0,0770%	0,2222%	0,3407%	0,6195%	0,0756%	0,0130%	0,2656%
Annualized Sharpe Ratio	0,9748	-1,8454	0,1478	0,1435	0,3138	-0,0371	-1,4308	0,0650	0,2349	0,2839	-0,0285	-4,0137	0,6402

TSV (0,03% cost per trade)	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06185%	0,06276%	0,21929%	0,29442%	0,3133%	-0,0011%	0,0411%	0,1012%	0,1420%	0,2343%	-0,0022%	-0,0486%	0,1700%
Annualized Volatility	0,0633%	0,1374%	0,3180%	0,4618%	0,7034%	0,0298%	0,1007%	0,2410%	0,3526%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	0,9764	0,4568	0,6896	0,6376	0,4455	-0,0371	0,4079	0,4198	0,4028	0,3746	-0,0285	-3,1397	0,6402

TSC (0,03% cost per trade)	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,06436%	-0,14582%	0,02766%	0,02199%	0,2528%	-0,0011%	-0,1215%	0,0118%	0,0976%	0,1771%	-0,0022%	0,0107%	0,1700%
Annualized Volatility	0,0634%	0,1376%	0,3181%	0,4620%	0,7032%	0,0298%	0,1007%	0,2410%	0,3525%	0,6255%	0,0756%	0,0155%	0,2656%
Annualized Sharpe Ratio	1,0150	-1,0594	0,0869	0,0476	0,3595	-0,0371	-1,2069	0,0489	0,2768	0,2831	-0,0285	0,6917	0,6402

Table 45: Results: Outperforming Investment Style Portfolios after Transaction Costs - Out-of-Sample (Bloomberg L.P., 2017, own graph)

TSC & TSV (0,01% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0022%	0,0010%	0,1076%	0,2353%	0,3819%	-0,0096%	-0,1194%	0,0724%	0,3845%	0,8538%	-0,0021%	-0,0018%	-0,0340%	0,0752%
Annualized Volatility	0,0090%	0,0341%	0,1983%	0,3655%	0,7283%	0,0127%	0,0531%	0,1575%	0,3485%	0,8595%	0,0398%	0,0603%	0,0062%	0,1298%
Annualized Sharpe Ratio	0,2473	0,0287	0,5428	0,6436	0,5244	-0,7575	-2,2480	0,4598	1,1033	0,9933	-0,0519	-0,0302	-5,5196	0,5790

TSV (0,01% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0170%	-0,0221%	0,1118%	0,2353%	0,3819%	-0,0221%	-0,0689%	-0,0163%	0,3464%	1,0590%	-0,0021%	0,0376%	-0,0378%	0,0020%
Annualized Volatility	0,0198%	0,0569%	0,2180%	0,3655%	0,7283%	0,0193%	0,0627%	0,2110%	0,4151%	0,9317%	0,0398%	0,0683%	0,0079%	0,1606%
Annualized Sharpe Ratio	-0,8583	-0,3880	0,5129	0,6436	0,5244	-1,1437	-1,0990	-0,0772	0,8343	1,1366	-0,0519	0,5513	-4,8092	0,0123

TSC (0,01% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0149%	0,0028%	0,1478%	0,2353%	0,3819%	-0,0016%	-0,0947%	0,1674%	0,4321%	0,6602%	-0,0021%	-0,0143%	-0,0272%	0,1503%
Annualized Volatility	0,0197%	0,0568%	0,2182%	0,3655%	0,7283%	0,0193%	0,0627%	0,2104%	0,4150%	0,9333%	0,0398%	0,0683%	0,0078%	0,1603%
Annualized Sharpe Ratio	0,7543	0,0498	0,6775	0,6436	0,5244	-0,0805	-1,5109	0,7956	1,0414	0,7074	-0,0519	-0,2097	-3,4600	0,9378

TSC & TSV (0,02% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0005%	-0,0336%	0,0403%	0,2353%	0,3819%	-0,0194%	-0,2154%	-0,0093%	0,3582%	0,8359%	-0,0021%	-0,0353%	-0,0688%	0,0441%
Annualized Volatility	0,0090%	0,0342%	0,1983%	0,3655%	0,7283%	0,0128%	0,0533%	0,1575%	0,3485%	0,8595%	0,0398%	0,0603%	0,0072%	0,1298%
Annualized Sharpe Ratio	0,0599	-0,9830	0,2033	0,6436	0,5244	-1,5207	-4,0387	-0,0591	1,0278	0,9725	-0,0519	-0,5854	-9,6204	0,3398

TSV (0,02% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0268%	-0,0700%	0,0242%	0,2353%	0,3819%	-0,0362%	-0,1027%	-0,0770%	0,3081%	1,0391%	-0,0021%	0,0376%	-0,0744%	-0,0446%
Annualized Volatility	0,0198%	0,0569%	0,2180%	0,3655%	0,7283%	0,0193%	0,0627%	0,2110%	0,4151%	0,9317%	0,0398%	0,0683%	0,0079%	0,1606%
Annualized Sharpe Ratio	-1,3583	-1,2320	0,1110	0,6436	0,5244	-1,8742	-1,6393	-0,3648	0,7422	1,1152	-0,0519	0,5513	-9,4830	-0,2779

TSC (0,02% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0149%	-0,0395%	0,1478%	0,2353%	0,3819%	-0,0114%	-0,1779%	0,0727%	0,4321%	0,6602%	-0,0021%	-0,0538%	-0,0568%	0,1390%
Annualized Volatility	0,0197%	0,0568%	0,2182%	0,3655%	0,7283%	0,0193%	0,0627%	0,2104%	0,4150%	0,9333%	0,0398%	0,0683%	0,0078%	0,1603%
Annualized Sharpe Ratio	0,7543	-0,6958	0,6775	0,6436	0,5244	-0,5919	-2,8375	0,3454	1,0414	0,7074	-0,0519	-0,7884	-7,2361	0,8672

TSC & TSV (0,03% cost per trade)	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0011%	-0,0681%	-0,0270%	0,2353%	0,3819%	-0,0292%	-0,3113%	-0,0910%	0,3318%	0,8180%	-0,0021%	-0,0688%	-0,1036%	0,0131%
Annualized Volatility	0,0090%	0,0345%	0,1983%	0,3655%	0,7283%	0,0129%	0,0537%	0,1576%	0,3484%	0,8595%	0,0398%	0,0604%	0,0085%	0,1298%
Annualized Sharpe Ratio	-0,1277	-1,9761	-0,1360	0,6436	0,5244	-2,2687	-5,7992	-0,5773	0,9523	0,9517	-0,0519	-1,1399	-12,1206	0,1006

TSV (0,03% cost per trade)	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-0,0367%	-0,1180%	-0,0633%	0,2353%	0,3819%	-0,0503%	-0,1366%	-0,1376%	0,2699%	1,0191%	-0,0021%	0,0376%	-0,1111%	-0,0912%
Annualized Volatility	0,0198%	0,0569%	0,2180%	0,3655%	0,7283%	0,0193%	0,0627%	0,2110%	0,4151%	0,9317%	0,0398%	0,0683%	0,0079%	0,1606%
Annualized Sharpe Ratio	-1,8584	-2,0758	-0,2905	0,6436	0,5244	-2,6046	-2,1794	-0,6523	0,6501	1,0938	-0,0519	0,5513	-14,1555	-0,5679

TSC (0,03% cost per trade)	United States					European Union					Australia		Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	0,0149%	-0,0819%	0,1478%	0,2353%	0,3819%	-0,0213%	-0,2611%	-0,0220%	0,4321%	0,6602%	-0,0021%	-0,0934%	-0,0864%	0,1277%
Annualized Volatility	0,0197%	0,0568%	0,2182%	0,3655%	0,7283%	0,0193%	0,0627%	0,2104%	0,4150%	0,9333%	0,0398%	0,0683%	0,0078%	0,1603%
Annualized Sharpe Ratio	0,7543	-1,4412	0,6775	0,6436	0,5244	-1,1033	-4,1632	-0,1045	1,0414	0,7074	-0,0519	-1,3670	-11,0114	0,7966

Table 46: Results: Outperforming Investment Style Portfolios after Transaction Costs - Inverted In-Sample (Bloomberg L.P., 2017, own graph)

2. CSC (0,01% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-2,6148%	-0,0854%	-2,8309%	0,0031%	0,0000%	-2,2423%	-0,0678%	-0,0578%	-0,0166%	0,0000%	0,0000%	-0,0335%	-0,0028%	0,0000%
Annualized Volatility	0,2409%	0,1359%	0,5612%	0,0118%	0,0000%	0,1446%	0,5411%	0,3228%	0,1812%	0,0000%	0,0000%	0,0262%	0,0080%	0,0000%
Annualized Sharpe Ratio	-10,8557	-0,6281	-5,0447	0,2598	0,0000	-15,5039	-0,1254	-0,1790	-0,0917	0,0000	0,0000	-1,2778	-0,3436	0,0000

2. CSC (0,02% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-5,0285%	-0,1042%	-5,1873%	0,0028%	0,0000%	-4,2986%	-0,7142%	-0,2744%	-0,0486%	0,0000%	0,0000%	-0,0922%	-0,0083%	0,0000%
Annualized Volatility	0,2409%	0,1362%	0,5609%	0,0118%	0,0000%	0,1611%	0,5418%	0,3238%	0,1813%	0,0000%	0,0000%	0,0292%	0,0086%	0,0000%
Annualized Sharpe Ratio	-20,8764	-0,7654	-9,2488	0,2423	0,0000	-26,6841	-1,3183	-0,8475	-0,2678	0,0000	0,0000	-3,1527	-0,9674	0,0000

2. CSC (0,03% cost per trade)	**United States**					**European Union**					**Australia**		**Japan**	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	IR1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-7,3828%	-0,1231%	-7,4869%	0,0026%	0,0000%	-6,3121%	-1,3564%	-0,4906%	-0,0805%	0,0000%	0,0000%	-0,1508%	-0,0139%	0,0000%
Annualized Volatility	0,2409%	0,1365%	0,5613%	0,0118%	0,0000%	0,1849%	0,5434%	0,3262%	0,1816%	0,0000%	0,0000%	0,0343%	0,0096%	0,0000%
Annualized Sharpe Ratio	-30,6506	-0,9014	-13,3387	0,2247	0,0000	-34,1325	-2,4961	-1,5040	-0,4432	0,0000	0,0000	-4,3955	-1,4488	0,0000

Table 47: Results: Outperforming Investment Style Portfolios after Transaction Costs - Inverted Out-of-Sample (Bloomberg L.P., 2017, own graph)

2. CSC (0,01% cost per trade)	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-2,7710%	-1,0064%	-1,2794%	0,2308%	0,1286%	-2,6017%	0,0468%	-0,0560%	-0,0032%	0,0000%	-0,6882%	-0,2417%	0,0000%
Annualized Volatility	0,3490%	0,4015%	0,6526%	0,8937%	1,0374%	0,2147%	0,2887%	0,0412%	0,0076%	0,0000%	0,0860%	0,0495%	0,0000%
Annualized Sharpe Ratio	-7,9394	-2,5066	-1,9604	0,2582	0,1240	-12,1176	0,1621	-1,3579	-0,4205	0,0000	-7,9994	-4,8861	0,0000

2. CSC (0,02% cost per trade)	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-5,1846%	-2,3926%	-2,5349%	-0,0845%	-0,1384%	-5,0195%	-0,2136%	-0,1096%	-0,0060%	0,0000%	-1,3609%	-0,4811%	0,0000%
Annualized Volatility	0,3490%	0,4298%	0,6737%	0,8917%	1,0373%	0,2148%	0,2907%	0,0628%	0,0151%	0,0000%	0,1679%	0,0986%	0,0000%
Annualized Sharpe Ratio	-14,8548	-5,5664	-3,7629	-0,0947	-0,1334	-23,3678	-0,7348	-1,7457	-0,3991	0,0000	-8,1055	-4,8764	0,0000

2. CSC (0,03% cost per trade)	United States					European Union					Australia	Japan	
	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Three-months	Two-years	Five-years	Ten-years	Thirty-years	Ten-years	Three-months	Ten-years
	ED1 Comdty	TU1 Comdty	FV1 Comdty	TY1 Comdty	US1 Comdty	ER1 Comdty	DU1 Comdty	OE1 Comdty	RX1 Comdty	UB1 Comdty	XM1 Comdty	YE1 Comdty	JB1 Comdty
Annualized Performance	-7,5387%	-3,7597%	-3,7748%	-0,3988%	-0,4047%	-7,3777%	-0,4733%	-0,1632%	-0,0088%	0,0000%	-2,0292%	-0,7199%	0,0000%
Annualized Volatility	0,3490%	0,4739%	0,7063%	0,8931%	1,0397%	0,2150%	0,2966%	0,0891%	0,0226%	0,0000%	0,2503%	0,1479%	0,0000%
Annualized Sharpe Ratio	-21,6000	-7,9334	-5,3442	-0,4465	-0,3893	-34,3198	-1,5959	-1,8322	-0,3916	0,0000	-8,1060	-4,8683	0,0000

Table 48: Ranking of Outperforming Portfolios after Transaction Costs (Bloomberg L.P., 2017, own graph)

Ranking of Outperformers after Transaction Costs (0,01% per Trade)							
In-Sample		Out-of-Sample		Inverted In-Sample		Inverted Out-of-Sample	
TSV	0,6420	TSV	0,9803	B&H	-0,9214	B&H	-0,5674
B&H	0,6114	B&H	0,9062	2. CSC	-7,6788	2. CSC	-3,9912
TSC	0,5534	TSC & TSV	0,8856				
TSC & TSV	0,5469	TSC	0,8195				
after 0,02% per Trade							
In-Sample		Out-of-Sample		Inverted In-Sample		Inverted Out-of-Sample	
TSV	0,6202	B&H	0,9062	B&H	-0,9214	B&H	-0,5674
B&H	0,5910	TSV	0,7852	2. CSC	-15,2182	2. CSC	-8,4875
TSC	0,3950	TSC	0,6955				
TSC & TSV	0,3636	TSC & TSV	0,6879				
after 0,03% per Trade							
In-Sample		Out-of-Sample		Inverted In-Sample		Inverted Out-of-Sample	
B&H	0,6114	B&H	0,9062	B&H	-0,9214	B&H	-0,5674
TSV	0,5983	TSV	0,5902	2. CSC	-22,5996	2. CSC	-12,9058
TSC	0,2366	TSC	0,5716				
TSC & TSV	0,1803	TSC & TSV	0,4903				

Table 49: Carry Profit and Loss of Carry Trade Portfolios (Bloomberg L.P. 2017, own graph)

	United States					European Union					Japan		Portfolio Carry
Treasury Interest Rate	Three months	Two years	Five years	Ten years	Thirty years	Three months	Two years	Five years	Ten years	Thirty years	Three months	Ten years	
In-Sample													
TSC	0,251%	0,025%	0,116%	0,148%	0,518%	0,237%	-0,023%	0,055%	0,171%	0,240%	0,010%	0,116%	1,862%
1. CSC	0,520%	-0,052%	0,152%	0,158%	0,439%	0,484%	-0,194%	-0,022%	0,279%	0,042%	0,016%	0,083%	1,905%
2. CSC	1,692%	-0,169%	0,003%	0,226%	0,038%	1,474%	-0,046%	-0,009%	-0,018%	0,000%	0,005%	0,000%	3,196%
B&H	0,251%	0,048%	0,126%	0,187%	0,322%	0,237%	0,018%	0,061%	0,125%	0,249%	0,010%	0,116%	1,749%
16.06.2003-02.09.2003													
TSC	0,077%	-0,472%	-2,167%	-3,645%	-5,390%	0,160%	-0,167%	-1,433%	-2,160%	-2,828%	0,000%	-3,595%	-21,620%
1. CSC	0,145%	0,114%	-2,534%	-4,586%	-0,341%	0,326%	0,047%	-0,980%	-2,712%	-3,091%	0,000%	-1,691%	-15,301%
2. CSC	0,333%	0,573%	-1,259%	0,066%	0,000%	1,263%	0,683%	0,000%	0,000%	0,000%	0,000%	0,000%	1,659%
B&H	0,077%	-0,547%	-2,167%	-3,645%	-5,390%	0,160%	-0,488%	-1,433%	-2,160%	-2,828%	0,000%	-3,595%	-22,016%
17.03.2004-14.06.2004													
TSC	0,060%	-0,762%	-1,761%	-2,518%	-3,589%	0,151%	-0,337%	-0,755%	-1,128%	-1,200%	0,001%	-1,371%	-13,207%
1. CSC	0,105%	-1,012%	-2,576%	-3,236%	-3,739%	0,286%	1,269%	1,203%	-1,106%	-0,989%	0,000%	-0,494%	-10,290%
2. CSC	0,072%	-0,117%	-0,220%	0,000%	0,000%	0,268%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,002%
B&H	0,060%	-0,762%	-1,761%	-2,518%	-3,589%	0,151%	-0,343%	-0,755%	-1,128%	-1,200%	0,001%	-1,371%	-13,214%
28.06.2005-14.11.2005													
TSC	0,258%	-0,273%	-0,653%	-0,942%	-1,634%	0,154%	-0,160%	-0,535%	-0,519%	-0,539%	0,000%	-0,454%	-5,299%
1. CSC	0,481%	-0,393%	-0,825%	-1,430%	-2,538%	0,266%	0,207%	-0,321%	-0,350%	-0,297%	0,000%	-0,159%	-5,359%
2. CSC	2,127%	-0,152%	-0,169%	0,000%	0,000%	0,636%	0,818%	0,000%	0,000%	0,000%	0,000%	0,000%	3,260%
B&H	0,258%	-0,296%	-0,653%	-0,942%	-1,634%	0,154%	-0,252%	-0,535%	-0,519%	-0,539%	0,000%	-0,454%	-5,413%
01.06.2005-01.06.2006													
TSC	0,300%	0,057%	0,232%	0,101%	0,257%	0,171%	-0,072%	-0,329%	-0,380%	-0,494%	-0,004%	-0,364%	-0,525%
1. CSC	0,560%	-0,271%	-0,588%	-1,065%	-1,746%	0,294%	0,028%	-0,195%	-0,227%	-0,098%	-0,002%	-0,077%	-3,386%
2. CSC	2,491%	-0,084%	-0,124%	4,567%	1,684%	0,715%	0,537%	0,000%	0,000%	0,000%	0,000%	0,000%	9,787%
B&H	0,043%	-0,031%	-0,065%	-0,100%	-0,154%	0,025%	-0,023%	-0,047%	-0,055%	-0,071%	-0,001%	-0,052%	-0,531%
Inverted out-of-sample													
TSC	0,259%	0,156%	0,215%	0,367%	0,332%	0,258%	0,149%	0,145%	0,064%	0,004%	0,029%	0,429%	2,407%
1. CSC	0,073%	0,064%	0,051%	0,053%	0,117%	0,071%	0,037%	0,026%	0,003%	-0,010%	0,004%	-0,002%	0,487%
2. CSC	1,849%	0,479%	0,050%	0,577%	0,368%	1,378%	0,358%	-0,002%	0,000%	0,000%	0,007%	0,000%	5,065%
B&H	0,259%	0,020%	0,074%	0,116%	0,127%	0,258%	-0,016%	0,032%	0,059%	0,004%	0,004%	0,060%	0,998%

	United States					European Union					Australia		Japan		Portfolio Carry
Treasury Interest Rate	Three months	Two years	Five years	Ten years	Thirty years	Three months	Two years	Five years	Ten years	Thirty years	Three months	Ten years	Three months	Ten years	
Out-of-Sample															
TSC	0,027%	0,001%	0,089%	0,241%	0,501%	0,030%	0,014%	0,130%	0,320%	0,719%	0,084%	0,295%	0,042%	0,163%	2,656%
1. CSC	0,048%	-0,002%	0,112%	0,251%	0,448%	0,075%	0,022%	0,183%	0,211%	0,345%	0,170%	-0,326%	0,189%	0,042%	1,769%
2. CSC	0,069%	-0,015%	0,037%	0,007%	0,000%	0,091%	0,068%	0,010%	0,000%	0,000%	0,790%	0,087%	0,220%	0,000%	1,363%
B&H	0,027%	0,001%	0,089%	0,241%	0,501%	0,030%	0,014%	0,130%	0,320%	0,719%	0,084%	0,295%	0,042%	0,163%	2,656%
05.11.2010-03.03.2011															
TSC	0,020%	-0,142%	-1,072%	-1,605%	-1,390%	1,703%	-0,059%	-0,657%	0,732%	8,207%	0,024%	-0,383%	0,009%	-0,642%	4,745%
1. CSC	0,029%	-0,126%	-1,102%	-2,062%	-1,428%	0,124%	-0,732%	-2,006%	-0,815%	-1,195%	0,000%	0,055%	-0,004%	-0,204%	-9,467%
2. CSC	0,018%	0,000%	-0,382%	-0,002%	0,000%	0,159%	2,837%	0,000%	0,000%	0,000%	0,255%	0,000%	0,000%	0,000%	2,885%
B&H	0,020%	-0,142%	-1,072%	-1,605%	-1,390%	0,071%	-0,350%	-0,979%	-1,496%	-2,938%	0,024%	-0,383%	-0,005%	-0,642%	-10,887%
Inverted In-Sample															
TSC	0,041%	0,062%	0,020%	0,072%	-0,003%	0,073%	0,140%	0,194%	-0,056%	-0,177%	0,201%	0,248%	0,011%	-0,026%	0,800%
1. CSC	0,078%	-0,053%	-0,002%	-0,027%	-0,234%	0,146%	-0,040%	-0,091%	0,630%	0,392%	0,383%	2,681%	0,012%	-0,006%	3,870%
2. CSC	0,160%	-0,060%	-0,126%	0,005%	0,000%	0,326%	0,788%	0,206%	0,027%	0,000%	0,000%	0,198%	0,003%	0,000%	1,526%
B&H	0,041%	-0,013%	0,045%	0,060%	-0,003%	0,073%	-0,084%	-0,127%	-0,203%	-0,519%	0,201%	-0,139%	0,010%	-0,026%	-0,684%

Table 50: Portfolio Correlations - In-Sample (Bloomberg L.P. 2017, own graph)

TSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1	
ED1	**1,00**	0,43	0,47	0,49	0,48	0,42	0,14	0,37	0,44	0,36	0,10	0,08	-0,11	
TU1	0,43	**1,00**	0,90	0,80	0,65	0,19	0,24	0,44	0,39	0,22	0,10	0,00	-0,05	
FV1	0,47	0,90	**1,00**	0,93	0,80	0,20	0,21	0,47	0,45	0,28	0,12	0,00	-0,04	
TY1	0,49	0,80	0,93	**1,00**	0,89	0,22	0,18	0,46	0,49	0,34	0,10	0,00	-0,02	
US1	0,48	0,65	0,80	0,89	**1,00**	0,23	0,13	0,43	0,48	0,39	0,09	0,02	-0,01	
ER1	0,42	0,19	0,20	0,22	0,23	**1,00**	0,05	0,39	0,46	0,39	0,16	0,07	-0,07	
DU1	0,14	0,24	0,21	0,18	0,13	0,05	**1,00**	0,54	0,37	0,24	0,03	0,05	0,00	
OE1	0,37	0,44	0,47	0,46	0,43	0,39	0,54	**1,00**	0,84	0,64	0,16	0,07	-0,01	
RX1	0,44	0,39	0,45	0,49	0,48	0,46	0,37	0,84	**1,00**	0,82	0,19	0,09	0,01	
UB1	0,36	0,22	0,28	0,34	0,39	0,39	0,24	0,64	0,82	**1,00**	0,16	0,09	0,00	
XM1	0,10	0,10	0,12	0,10	0,09	0,16	0,03	0,16	0,19	0,16	**1,00**	0,19	0,00	
YE1	0,08	0,00	0,00	0,00	0,02	0,07	0,05	0,07	0,09	0,09	0,19	**1,00**	0,01	
JB1	-0,11	-0,05	-0,04	-0,02	-0,01	-0,07	0,00	-0,01	0,01	0,00	0,00	0,01	**1,00**	

1. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1	
ED1	**1,00**	-0,04	0,31	0,32	0,14	0,42	-0,22	-0,10	0,07	0,18	0,07	0,08	0,09	
TU1	-0,04	**1,00**	0,69	0,58	0,37	-0,05	-0,02	0,04	-0,06	-0,02	-0,02	-0,04	-0,01	
FV1	0,31	0,69	**1,00**	0,92	0,52	0,13	-0,17	-0,04	-0,01	0,10	0,06	-0,02	0,00	
TY1	0,32	0,58	0,92	**1,00**	0,66	0,13	-0,18	-0,05	-0,04	0,06	0,07	0,00	0,02	
US1	0,14	0,37	0,52	0,66	**1,00**	0,02	-0,09	-0,06	-0,13	-0,13	0,01	0,00	0,03	
ER1	0,42	-0,05	0,13	0,13	0,02	**1,00**	-0,36	-0,22	0,11	0,24	0,14	0,07	0,09	
DU1	-0,22	-0,02	-0,17	-0,18	-0,09	-0,36	**1,00**	0,71	-0,15	-0,22	-0,10	0,01	-0,03	
OE1	-0,10	0,04	-0,04	-0,05	-0,06	-0,22	0,71	**1,00**	-0,16	-0,17	-0,05	0,04	0,00	
RX1	0,07	-0,06	-0,01	-0,04	-0,13	0,11	-0,15	-0,16	**1,00**	0,50	0,06	-0,04	-0,01	
UB1	0,18	-0,02	0,10	0,06	-0,13	0,24	-0,22	-0,17	0,50	**1,00**	0,13	-0,01	0,01	
XM1	0,07	-0,02	0,06	0,07	0,01	0,14	-0,10	-0,05	0,06	0,13	**1,00**	0,08	0,13	
YE1	0,08	-0,04	-0,02	0,00	0,00	0,07	0,01	0,04	-0,04	-0,01	0,08	**1,00**	0,38	
JB1	0,09	-0,01	0,00	0,02	0,03	0,09	-0,03	0,00	-0,01	0,01	0,13	0,38	**1,00**	

2. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1	
ED1	**1,00**	-0,29	-0,13	-0,30	-0,22	0,39	-0,24	-0,13	-0,07	0,00	0,04	0,06	0,00	
TU1	-0,29	**1,00**	0,77	0,03	0,02	-0,18	0,07	0,01	0,00	0,00	-0,08	-0,04	0,00	
FV1	-0,13	0,77	**1,00**	-0,03	0,00	-0,11	-0,02	-0,08	-0,09	0,00	-0,06	-0,02	0,00	
TY1	-0,30	0,03	-0,03	**1,00**	0,75	-0,07	0,05	0,13	0,00	0,00	0,00	-0,06	0,00	
US1	-0,22	0,02	0,00	0,75	**1,00**	-0,06	0,01	0,00	0,00	0,00	0,00	-0,04	0,00	
ER1	0,39	-0,18	-0,11	-0,07	-0,06	**1,00**	-0,40	-0,07	-0,01	0,00	0,15	0,05	0,00	
DU1	-0,24	0,07	-0,02	0,05	0,01	-0,40	**1,00**	0,37	0,14	0,00	-0,12	-0,02	0,00	
OE1	-0,13	0,01	-0,08	0,13	0,00	-0,07	0,37	**1,00**	0,44	0,00	0,00	-0,06	0,00	
RX1	-0,07	0,00	-0,09	0,00	0,00	-0,01	0,14	0,44	**1,00**	0,00	0,00	0,00	0,00	
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	
XM1	0,04	-0,08	-0,06	0,00	0,00	0,15	-0,12	0,00	0,00	0,00	**1,00**	0,00	0,00	
YE1	0,06	-0,04	-0,02	-0,06	-0,04	0,05	-0,02	-0,06	0,00	0,00	0,00	**1,00**	0,00	
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	

TSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1	
ED1	**1,00**	0,59	0,39	0,35	0,28	0,28	0,28	0,25	0,23	0,19	0,06	-0,01	0,08	
TU1	0,59	**1,00**	0,80	0,74	0,65	0,33	0,51	0,51	0,49	0,41	0,11	0,00	0,07	
FV1	0,39	0,80	**1,00**	0,97	0,90	0,36	0,61	0,64	0,63	0,52	0,13	0,00	0,10	
TY1	0,35	0,74	0,97	**1,00**	0,96	0,35	0,62	0,66	0,66	0,56	0,11	0,00	0,10	
US1	0,28	0,65	0,90	0,96	**1,00**	0,30	0,57	0,63	0,65	0,58	0,10	0,00	0,09	
ER1	0,28	0,33	0,36	0,35	0,30	**1,00**	0,69	0,62	0,52	0,40	0,16	0,03	0,09	
DU1	0,28	0,51	0,61	0,62	0,57	0,69	**1,00**	0,95	0,86	0,70	0,18	0,06	0,12	
OE1	0,25	0,51	0,64	0,66	0,63	0,62	0,95	**1,00**	0,95	0,82	0,20	0,06	0,14	
RX1	0,23	0,49	0,63	0,66	0,65	0,52	0,86	0,95	**1,00**	0,91	0,21	0,05	0,14	
UB1	0,19	0,41	0,52	0,56	0,58	0,40	0,70	0,82	0,91	**1,00**	0,17	0,05	0,11	
XM1	0,06	0,11	0,13	0,11	0,10	0,16	0,18	0,20	0,21	0,17	**1,00**	0,04	0,24	
YE1	-0,01	0,00	0,00	0,00	0,00	0,03	0,06	0,06	0,05	0,05	0,04	**1,00**	0,12	
JB1	0,08	0,07	0,10	0,10	0,09	0,09	0,12	0,14	0,14	0,11	0,24	0,12	**1,00**	

TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1	
ED1	**1,00**	0,03	0,05	0,06	0,07	0,16	0,08	0,08	-0,09	-0,09	0,00	-0,02	0,01	
TU1	0,03	**1,00**	0,72	0,62	0,46	0,06	0,22	0,25	0,01	0,01	-0,06	0,00	0,01	
FV1	0,05	0,72	**1,00**	0,81	0,60	0,05	0,21	0,26	0,02	0,02	-0,06	-0,01	0,02	
TY1	0,06	0,62	0,81	**1,00**	0,77	0,06	0,24	0,29	0,03	0,03	-0,03	-0,01	0,03	
US1	0,07	0,46	0,60	0,77	**1,00**	0,05	0,18	0,26	0,04	0,04	0,00	-0,01	0,02	
ER1	0,16	0,06	0,05	0,06	0,05	**1,00**	0,20	0,15	-0,03	-0,05	0,00	0,03	-0,03	
DU1	0,08	0,22	0,21	0,24	0,18	0,20	**1,00**	0,68	0,01	0,01	0,02	0,00	0,01	
OE1	0,08	0,25	0,26	0,29	0,26	0,15	0,68	**1,00**	0,03	0,03	0,02	0,00	0,01	
RX1	-0,09	0,01	0,02	0,03	0,04	-0,03	0,01	0,03	**1,00**	0,77	0,03	-0,01	0,00	
UB1	-0,09	0,01	0,02	0,03	0,04	-0,05	0,01	0,03	0,77	**1,00**	0,04	-0,01	0,03	
XM1	0,00	-0,06	-0,06	-0,03	0,00	0,00	0,02	0,02	0,03	0,04	**1,00**	0,01	0,04	
YE1	-0,02	0,00	-0,01	-0,01	-0,01	0,03	0,00	0,00	-0,01	-0,01	0,01	**1,00**	0,06	
JB1	0,01	0,01	0,02	0,03	0,02	-0,03	0,01	0,01	0,00	0,03	0,04	0,06	**1,00**	

CSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1	
ED1	**1,00**	0,31	-0,10	0,00	0,08	0,04	0,00	0,00	-0,13	-0,10	0,02	-0,03	0,00	
TU1	0,31	**1,00**	0,00	0,00	-0,03	0,00	0,00	0,00	-0,08	-0,05	0,00	-0,01	0,00	
FV1	-0,10	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,05	0,00	
TY1	0,00	0,00	0,00	**1,00**	0,36	0,00	0,00	0,00	0,00	0,02	-0,02	-0,01	0,00	
US1	0,08	-0,03	0,00	0,36	**1,00**	0,00	0,00	0,00	0,05	0,35	0,07	-0,02	0,00	
ER1	0,04	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,02	-0,01	0,00	0,00	
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	
RX1	-0,13	-0,08	0,00	0,00	0,05	0,00	0,00	0,00	**1,00**	0,69	0,12	-0,04	0,00	
UB1	-0,10	-0,05	0,00	0,02	0,35	0,02	0,00	0,00	0,69	**1,00**	0,13	-0,04	0,00	
XM1	0,02	0,00	-0,01	-0,02	0,07	-0,01	0,00	0,00	0,12	0,13	**1,00**	-0,13	0,00	
YE1	-0,03	-0,01	-0,05	-0,01	-0,02	0,00	0,00	0,00	-0,04	-0,04	-0,13	**1,00**	0,00	
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	

CSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,09	-0,14	-0,20	-0,15	0,11	0,01	-0,05	-0,06	-0,01	0,06	0,02	0,02
TU1	-0,09	**1,00**	0,45	0,26	0,02	-0,02	-0,09	-0,10	-0,10	-0,02	-0,08	-0,05	0,01
FV1	-0,14	0,45	**1,00**	0,55	0,18	-0,09	-0,17	-0,06	-0,10	0,02	-0,05	0,01	0,02
TY1	-0,20	0,26	0,55	**1,00**	0,46	-0,09	-0,12	-0,04	-0,09	-0,02	-0,07	-0,03	0,02
US1	-0,15	0,02	0,18	0,46	**1,00**	-0,05	-0,09	-0,14	-0,08	0,03	0,00	-0,04	0,01
ER1	0,11	-0,02	-0,09	-0,09	-0,05	**1,00**	0,02	-0,06	-0,09	0,00	0,02	0,03	-0,01
DU1	0,01	-0,09	-0,17	-0,12	-0,09	0,02	**1,00**	0,43	0,18	-0,01	-0,01	-0,01	-0,01
OE1	-0,05	-0,10	-0,06	-0,04	-0,14	-0,06	0,43	**1,00**	0,40	-0,02	-0,05	0,01	-0,04
RX1	-0,06	-0,10	-0,10	-0,09	-0,08	-0,09	0,18	0,40	**1,00**	0,00	-0,03	-0,03	-0,07
UB1	-0,01	-0,02	0,02	-0,02	0,03	0,00	-0,01	-0,02	0,00	**1,00**	-0,03	0,04	-0,05
XM1	0,06	-0,08	-0,05	-0,07	0,00	0,02	-0,01	-0,05	-0,03	-0,03	**1,00**	0,03	0,04
YE1	0,02	-0,05	0,01	-0,03	-0,04	0,03	-0,01	0,01	-0,03	0,04	0,03	**1,00**	0,15
JB1	0,02	0,01	0,02	0,02	0,01	-0,01	-0,01	-0,04	-0,07	-0,05	0,04	0,15	**1,00**

B&H	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,56	0,78	0,74	0,64	0,42	0,56	0,53	0,49	0,38	0,10	0,08	0,09
TU1	0,56	**1,00**	0,61	0,62	0,57	0,69	1,00	0,95	0,86	0,70	0,18	0,10	0,12
FV1	0,78	0,61	**1,00**	0,97	0,90	0,36	0,61	0,64	0,63	0,52	0,13	0,07	0,10
TY1	0,74	0,62	0,97	**1,00**	0,96	0,35	0,62	0,66	0,66	0,56	0,11	0,07	0,10
US1	0,64	0,57	0,90	0,96	**1,00**	0,30	0,57	0,63	0,65	0,58	0,10	0,06	0,09
ER1	0,42	0,69	0,36	0,35	0,30	**1,00**	0,69	0,62	0,52	0,40	0,16	0,07	0,09
DU1	0,56	1,00	0,61	0,62	0,57	0,69	**1,00**	0,95	0,86	0,70	0,18	0,10	0,12
OE1	0,53	0,95	0,64	0,66	0,63	0,62	0,95	**1,00**	0,95	0,82	0,20	0,11	0,14
RX1	0,49	0,86	0,63	0,66	0,65	0,52	0,86	0,95	**1,00**	0,91	0,21	0,11	0,14
UB1	0,38	0,70	0,52	0,56	0,58	0,40	0,70	0,82	0,91	**1,00**	0,17	0,10	0,11
XM1	0,10	0,18	0,13	0,11	0,10	0,16	0,18	0,20	0,21	0,17	**1,00**	0,19	0,24
YE1	0,08	0,10	0,07	0,07	0,06	0,07	0,10	0,11	0,11	0,10	0,19	**1,00**	0,59
JB1	0,09	0,12	0,10	0,10	0,09	0,09	0,12	0,14	0,14	0,11	0,24	0,59	**1,00**

Table 51: Portfolio Correlations - Out-of-Sample (Bloomberg L.P. 2017, own graph)

TSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,39	0,29	0,20	0,10	0,17	-0,06	-0,04	0,02	0,04	0,00	0,02	0,03	0,02
TU1	0,39	**1,00**	0,82	0,72	0,58	0,06	0,05	0,21	0,35	0,35	0,04	0,09	0,02	0,08
FV1	0,29	0,82	**1,00**	0,96	0,83	0,09	-0,04	0,30	0,55	0,51	0,04	0,09	0,00	0,09
TY1	0,20	0,72	0,96	**1,00**	0,93	0,09	-0,09	0,32	0,62	0,58	0,06	0,08	0,00	0,11
US1	0,10	0,58	0,83	0,93	**1,00**	0,07	-0,14	0,28	0,62	0,61	0,06	0,06	0,00	0,10
ER1	0,17	0,06	0,09	0,09	0,07	**1,00**	-0,02	0,29	0,20	0,14	0,06	0,03	0,03	0,00
DU1	-0,06	0,05	-0,04	-0,09	-0,14	-0,02	**1,00**	0,19	-0,21	-0,20	0,00	0,04	-0,03	0,00
OE1	-0,04	0,21	0,30	0,32	0,28	0,29	0,19	**1,00**	0,48	0,36	0,04	0,11	0,03	0,08
RX1	0,02	0,35	0,55	0,62	0,62	0,20	-0,21	0,48	**1,00**	0,93	0,11	0,16	0,02	0,17
UB1	0,04	0,35	0,51	0,58	0,61	0,14	-0,20	0,36	0,93	**1,00**	0,12	0,18	0,01	0,17
XM1	0,00	0,04	0,04	0,06	0,06	0,06	0,00	0,04	0,11	0,12	**1,00**	0,19	0,00	0,00
YE1	0,02	0,09	0,09	0,08	0,06	0,03	0,04	0,11	0,16	0,18	0,19	**1,00**	0,05	0,27
IR1	0,03	0,02	0,00	0,00	0,00	0,03	-0,03	0,03	0,02	0,01	0,09	0,05	**1,00**	0,17
JB1	0,02	0,08	0,09	0,11	0,10	0,00	0,00	0,08	0,17	0,17	0,19	0,27	0,17	**1,00**

1. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,49	0,38	0,27	0,17	0,07	-0,05	-0,05	0,09	0,13	0,01	0,01	0,01	0,05
TU1	0,49	**1,00**	0,90	0,77	0,62	-0,02	0,10	0,26	0,42	0,42	0,05	-0,01	0,00	0,00
FV1	0,38	0,90	**1,00**	0,94	0,81	-0,01	0,15	0,37	0,54	0,51	0,05	-0,02	0,00	0,00
TY1	0,27	0,77	0,94	**1,00**	0,92	0,00	0,18	0,45	0,61	0,56	0,06	-0,05	0,00	0,00
US1	0,17	0,62	0,81	0,92	**1,00**	-0,01	0,16	0,43	0,61	0,59	0,07	-0,08	0,00	0,05
ER1	0,07	-0,02	-0,01	0,00	-0,01	**1,00**	0,29	0,20	0,00	-0,03	0,03	-0,03	0,05	0,00
DU1	-0,05	0,10	0,15	0,18	0,16	0,29	**1,00**	0,70	0,23	0,17	0,03	-0,03	0,00	-0,01
OE1	-0,05	0,26	0,37	0,45	0,43	0,20	0,70	**1,00**	0,70	0,56	0,06	-0,07	-0,01	-0,04
RX1	0,09	0,42	0,54	0,61	0,61	0,00	0,23	0,70	**1,00**	0,87	0,10	-0,04	-0,04	-0,06
UB1	0,13	0,42	0,51	0,56	0,59	-0,03	0,17	0,56	0,87	**1,00**	0,11	-0,04	-0,06	0,00
XM1	0,01	0,05	0,05	0,06	0,07	0,03	0,03	0,06	0,10	0,11	**1,00**	0,13	0,00	-0,01
YE1	0,01	-0,01	-0,02	-0,05	-0,08	-0,03	-0,03	-0,07	-0,04	-0,04	-0,44	**1,00**	-0,01	1,00
IR1	0,01	0,00	0,00	0,00	0,00	0,05	0,00	-0,01	-0,04	-0,06	0,01	-0,01	**1,00**	-0,01
JB1	0,05	0,09	0,10	0,11	0,09	-0,01	0,04	0,10	0,14	0,15	0,13	-0,07	-0,01	**1,00**

2. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,64	0,50	0,01	0,00	-0,02	0,02	0,03	0,00	0,00	0,02	0,00	0,02	0,00
TU1	0,64	**1,00**	0,75	0,00	0,00	-0,10	-0,02	-0,04	0,00	0,00	0,03	0,00	-0,01	-0,01
FV1	0,50	0,75	**1,00**	0,00	0,00	-0,04	-0,23	-0,18	0,00	0,00	0,05	-0,04	-0,01	0,00
TY1	0,01	0,00	0,00	**1,00**	0,00	0,00	-0,03	0,00	0,00	0,00	-0,02	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05
ER1	-0,02	-0,10	-0,04	0,00	0,00	**1,00**	-0,33	-0,20	0,00	0,00	0,06	-0,02	0,05	0,00
DU1	0,02	-0,02	-0,23	-0,03	0,00	-0,33	**1,00**	0,51	0,00	0,00	-0,08	0,06	0,00	0,01
OE1	0,03	-0,04	-0,18	0,00	0,00	-0,20	0,51	**1,00**	0,00	0,00	-0,02	0,06	0,01	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
XM1	0,02	0,03	0,05	-0,02	0,00	0,06	-0,08	-0,02	0,00	0,00	**1,00**	0,00	0,00	0,00
YE1	0,00	0,00	-0,04	0,00	0,00	-0,02	0,06	0,06	0,00	0,00	-0,35	**1,00**	0,00	1,00
IR1	0,02	-0,01	-0,01	0,00	0,00	0,05	0,00	0,01	0,00	0,00	0,01	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,42	-0,06	-0,02	0,04	0,03	-0,10	0,03	0,08	0,06	0,02	0,04	0,00	0,03
TU1	0,42	**1,00**	-0,14	-0,32	-0,24	0,02	0,05	0,00	-0,16	-0,14	-0,02	-0,03	0,00	-0,01
FV1	-0,06	-0,14	**1,00**	0,59	0,49	-0,04	-0,01	0,04	-0,01	0,16	0,05	0,08	-0,01	0,00
TY1	-0,02	-0,32	0,59	**1,00**	0,93	-0,03	-0,20	-0,05	0,25	0,43	0,06	0,13	0,00	0,01
US1	0,04	-0,24	0,49	0,93	**1,00**	-0,04	-0,21	-0,09	0,20	0,44	0,06	0,13	0,01	-0,01
ER1	0,03	0,02	-0,04	-0,03	-0,04	**1,00**	0,24	0,23	0,01	-0,02	0,01	0,03	-0,01	0,02
DU1	-0,10	0,05	-0,01	-0,20	-0,21	0,24	**1,00**	0,40	-0,13	-0,24	-0,01	-0,07	0,02	0,06
OE1	0,03	0,00	0,04	-0,05	-0,09	0,23	0,40	**1,00**	0,30	0,00	0,01	-0,03	0,06	0,01
RX1	0,08	-0,16	-0,01	0,25	0,20	0,01	-0,13	0,30	**1,00**	0,49	0,03	0,07	0,01	-0,03
UB1	0,06	-0,14	0,16	0,43	0,44	-0,02	-0,24	0,00	0,49	**1,00**	0,09	0,14	-0,03	0,00
XM1	0,02	-0,02	0,05	0,06	0,06	0,01	-0,01	0,01	0,03	0,09	**1,00**	0,08	0,00	0,06
YE1	0,04	-0,03	0,08	0,13	0,13	0,03	-0,07	-0,03	0,07	0,14	0,60	**1,00**	-0,12	1,00
IR1	0,00	0,00	-0,01	0,00	0,01	-0,01	0,02	0,06	0,01	-0,03	-0,03	-0,12	**1,00**	0,06
JB1	0,03	-0,05	0,00	0,00	-0,01	0,00	0,01	0,04	0,07	0,01	0,08	0,05	0,06	**1,00**

CSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,00	0,13	-0,02	0,19	0,05	-0,58	-0,05	0,00	-0,30	-0,28	-0,02	0,01	-0,05
TU1	0,00	**1,00**	-0,28	-0,17	-0,45	0,10	0,27	0,04	0,00	0,07	-0,08	-0,02	0,02	0,00
FV1	0,13	-0,28	**1,00**	0,00	0,74	0,00	-0,48	0,00	0,00	-0,22	0,28	0,04	0,00	0,03
TY1	-0,02	-0,17	0,00	**1,00**	0,47	-0,05	-0,06	-0,07	-0,23	0,00	0,01	0,02	0,03	0,02
US1	0,19	-0,45	0,74	0,47	**1,00**	-0,05	-0,54	-0,12	-0,14	-0,08	0,19	0,05	0,02	0,01
ER1	0,05	0,10	0,00	-0,05	-0,05	**1,00**	0,12	0,08	0,15	0,00	-0,01	-0,03	0,01	0,01
DU1	-0,58	0,27	-0,48	-0,06	-0,54	0,12	**1,00**	0,25	0,03	0,42	-0,02	-0,04	0,01	0,00
OE1	-0,05	0,04	0,00	-0,07	-0,12	0,08	0,25	**1,00**	0,07	0,00	0,03	-0,07	0,00	0,00
RX1	0,00	0,00	0,00	-0,23	-0,14	0,15	0,03	0,07	**1,00**	0,00	-0,03	0,00	0,00	0,00
UB1	-0,30	0,07	-0,22	0,00	-0,08	0,00	0,42	0,00	0,00	**1,00**	-0,27	-0,02	0,00	0,00
XM1	-0,28	-0,08	0,28	0,01	0,19	-0,01	-0,02	0,03	-0,03	-0,27	**1,00**	0,08	0,00	0,07
YE1	-0,02	-0,02	0,04	0,02	0,05	-0,03	-0,04	-0,07	0,00	-0,02	0,02	**1,00**	0,01	1,00
IR1	0,01	0,02	0,00	0,03	0,02	0,01	0,01	0,00	0,00	0,00	-0,04	0,01	**1,00**	0,07
JB1	-0,05	-0,01	0,18	-0,03	0,11	-0,01	-0,09	-0,01	0,00	0,00	0,08	0,08	0,07	**1,00**

TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,07	0,03	0,05	0,07	0,07	-0,01	0,04	0,06	0,07	0,05	0,04	0,00	0,00
TU1	0,07	**1,00**	0,70	0,49	0,30	0,00	0,11	0,11	-0,01	-0,04	-0,01	0,03	-0,04	-0,02
FV1	0,03	0,70	**1,00**	0,76	0,50	-0,01	0,16	0,21	0,00	-0,02	-0,02	0,05	0,00	0,00
TY1	0,05	0,49	0,76	**1,00**	0,73	0,00	0,13	0,25	0,01	-0,01	0,04	0,02	-0,02	-0,02
US1	0,07	0,30	0,50	0,73	**1,00**	0,00	0,12	0,22	0,04	0,02	0,04	0,03	-0,02	-0,01
ER1	0,07	0,00	-0,01	0,00	0,00	**1,00**	0,08	0,13	-0,01	-0,03	-0,09	0,08	0,00	0,03
DU1	-0,01	0,11	0,16	0,13	0,12	0,08	**1,00**	0,63	0,03	0,04	-0,02	0,04	-0,03	-0,02
OE1	0,04	0,11	0,21	0,25	0,22	0,13	0,63	**1,00**	0,04	0,03	0,05	0,06	-0,02	0,00
RX1	0,06	-0,01	0,00	0,01	0,04	-0,01	0,03	0,04	**1,00**	0,78	0,01	-0,03	-0,03	0,02
UB1	0,07	-0,04	-0,02	-0,01	0,02	-0,03	0,04	0,03	0,78	**1,00**	0,01	-0,02	-0,01	0,00
XM1	0,05	-0,01	-0,02	0,04	0,04	-0,09	-0,02	0,05	0,01	0,01	**1,00**	0,11	0,06	0,00
YE1	0,04	0,03	0,05	0,02	0,03	0,08	0,04	0,06	-0,03	-0,02	0,11	**1,00**	-0,01	0,13
IR1	0,00	-0,04	0,00	-0,02	-0,02	0,00	-0,03	-0,02	-0,03	-0,01	0,06	-0,01	**1,00**	0,03
JB1	0,00	-0,02	0,00	-0,02	-0,01	0,03	-0,02	0,00	0,02	0,00	0,00	0,13	0,03	**1,00**

CSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	-0,04	0,02	0,04	0,14	0,09	0,02	0,05	0,01	0,00	0,05	0,00	0,00	-0,03
TU1	-0,04	**1,00**	0,51	0,24	0,06	-0,08	0,01	-0,05	-0,06	-0,02	-0,01	0,00	-0,02	-0,01
FV1	0,02	0,51	**1,00**	0,57	0,23	-0,05	-0,01	-0,04	-0,04	0,00	-0,03	0,02	0,01	-0,04
TY1	0,04	0,24	0,57	**1,00**	0,58	-0,01	-0,03	-0,03	-0,02	0,02	-0,05	0,00	0,03	-0,06
US1	0,14	0,06	0,23	0,58	**1,00**	0,03	-0,04	0,02	0,01	-0,01	-0,06	0,03	0,05	-0,04
ER1	0,09	-0,08	-0,05	-0,01	0,03	**1,00**	-0,05	-0,02	-0,07	-0,01	-0,06	0,03	-0,04	0,02
DU1	0,02	0,01	-0,01	-0,03	-0,04	-0,05	**1,00**	0,36	0,15	-0,02	-0,04	-0,01	-0,03	0,00
OE1	0,05	-0,05	-0,04	-0,03	0,02	-0,02	0,36	**1,00**	0,52	0,02	0,00	0,01	-0,02	0,00
RX1	0,01	-0,06	-0,04	-0,02	0,01	-0,07	0,15	0,52	**1,00**	0,05	0,00	0,00	-0,06	-0,03
UB1	0,00	-0,02	0,00	0,02	-0,01	-0,01	-0,02	0,02	0,05	**1,00**	0,02	0,02	0,00	-0,02
XM1	0,05	-0,01	-0,03	-0,05	-0,06	-0,06	-0,04	0,00	0,00	0,02	**1,00**	0,11	0,06	-0,01
YE1	0,00	0,00	0,02	0,00	0,03	0,03	-0,01	0,01	0,00	0,02	0,11	**1,00**	-0,02	0,11
IR1	0,00	-0,02	0,01	0,03	0,05	-0,04	-0,03	-0,02	-0,06	0,00	0,06	-0,02	**1,00**	0,02
JB1	-0,03	-0,01	-0,04	-0,06	-0,04	0,02	0,00	0,00	-0,03	-0,02	-0,01	0,11	0,02	**1,00**

B&H	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,41	0,29	0,20	0,10	0,21	-0,04	-0,01	0,02	0,04	0,00	0,01	0,02	0,01
TU1	0,41	**1,00**	0,88	0,79	0,64	0,11	0,31	0,38	0,42	0,41	0,05	0,11	0,03	0,07
FV1	0,29	0,88	**1,00**	0,96	0,83	0,13	0,40	0,51	0,55	0,51	0,04	0,12	0,01	0,09
TY1	0,20	0,79	0,96	**1,00**	0,93	0,13	0,43	0,57	0,62	0,58	0,06	0,13	0,00	0,10
US1	0,10	0,64	0,83	0,93	**1,00**	0,12	0,41	0,55	0,62	0,61	0,06	0,13	0,00	0,09
ER1	0,21	0,11	0,13	0,13	0,12	**1,00**	0,55	0,39	0,27	0,20	0,07	0,08	0,03	0,03
DU1	-0,04	0,31	0,40	0,43	0,41	0,55	**1,00**	0,88	0,71	0,58	0,10	0,16	0,04	0,09
OE1	-0,01	0,38	0,51	0,57	0,55	0,39	0,88	**1,00**	0,92	0,79	0,09	0,20	0,05	0,13
RX1	0,02	0,42	0,55	0,62	0,62	0,27	0,71	0,92	**1,00**	0,93	0,11	0,24	0,07	0,16
UB1	0,04	0,41	0,51	0,58	0,61	0,20	0,58	0,79	0,93	**1,00**	0,12	0,26	0,07	0,16
XM1	0,00	0,05	0,04	0,06	0,06	0,07	0,10	0,09	0,11	0,12	**1,00**	0,60	0,10	0,19
YE1	0,01	0,11	0,12	0,13	0,13	0,08	0,16	0,20	0,24	0,26	0,60	**1,00**	0,18	0,41
IR1	0,02	0,03	0,01	0,00	0,00	0,03	0,04	0,05	0,07	0,07	0,10	0,18	**1,00**	0,41
JB1	0,01	0,07	0,09	0,10	0,09	0,03	0,09	0,13	0,16	0,16	0,19	0,41	0,41	**1,00**

Table 52: Portfolio Correlations - 16.06.2003-02.09.2003 (Bloomberg L.P. 2017, own graph)

TSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,67	0,86	0,82	0,75	0,46	0,67	0,67	0,63	0,59	0,21	-0,10	-0,17
TU1	0,67	**1,00**	0,64	0,63	0,54	0,80	1,00	0,96	0,89	0,77	0,42	-0,02	0,14
FV1	0,86	0,64	**1,00**	0,98	0,92	0,35	0,64	0,70	0,72	0,71	0,26	-0,01	-0,06
TY1	0,82	0,63	0,98	**1,00**	0,97	0,33	0,63	0,70	0,73	0,72	0,23	0,00	-0,03
US1	0,75	0,54	0,92	0,97	**1,00**	0,24	0,54	0,62	0,67	0,68	0,13	-0,04	-0,05
ER1	0,46	0,80	0,35	0,33	0,24	**1,00**	0,80	0,68	0,56	0,40	0,40	-0,04	0,08
DU1	0,67	1,00	0,64	0,63	0,54	0,80	**1,00**	0,96	0,89	0,77	0,42	-0,02	0,14
OE1	0,67	0,96	0,70	0,70	0,62	0,68	0,96	**1,00**	0,97	0,88	0,43	-0,01	0,18
RX1	0,63	0,89	0,72	0,73	0,67	0,56	0,89	0,97	**1,00**	0,96	0,40	-0,01	0,17
UB1	0,59	0,77	0,71	0,72	0,68	0,40	0,77	0,88	0,96	**1,00**	0,31	0,01	0,11
XM1	0,21	0,42	0,26	0,23	0,13	0,40	0,42	0,43	0,40	0,31	**1,00**	0,04	0,14
YE1	-0,10	-0,02	-0,01	0,00	-0,04	-0,04	-0,02	-0,01	-0,01	0,01	0,04	**1,00**	0,57
JB1	-0,17	0,14	-0,06	-0,03	-0,05	0,08	0,14	0,18	0,17	0,11	0,14	0,57	**1,00**

1. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,16	0,40	0,49	-0,02	0,42	0,41	0,57	0,48	0,43	0,18	-0,13	-0,27
TU1	-0,16	**1,00**	0,63	0,45	0,77	-0,20	0,19	-0,15	-0,28	-0,26	-0,24	0,08	0,23
FV1	0,40	0,63	**1,00**	0,93	0,70	0,08	0,52	0,33	0,15	0,13	0,02	-0,06	0,12
TY1	0,49	0,45	0,93	**1,00**	0,71	0,14	0,47	0,38	0,24	0,20	0,03	-0,04	0,18
US1	-0,02	0,77	0,70	0,71	**1,00**	-0,17	0,18	-0,12	-0,27	-0,28	-0,32	-0,05	0,26
ER1	0,42	-0,20	0,08	0,14	-0,17	**1,00**	0,41	0,72	0,61	0,49	0,40	-0,12	0,07
DU1	0,41	0,19	0,52	0,47	0,18	0,41	**1,00**	0,69	0,26	0,22	0,13	0,05	0,09
OE1	0,57	-0,15	0,33	0,38	-0,12	0,72	0,69	**1,00**	0,80	0,75	0,43	-0,06	0,08
RX1	0,48	-0,28	0,15	0,24	-0,27	0,61	0,26	0,80	**1,00**	0,97	0,51	-0,08	0,06
UB1	0,43	-0,26	0,13	0,20	-0,28	0,49	0,22	0,75	0,97	**1,00**	0,44	-0,02	0,01
XM1	0,18	-0,24	0,02	0,03	-0,32	0,40	0,13	0,43	0,51	0,44	**1,00**	0,13	0,13
YE1	-0,13	0,08	-0,06	-0,04	-0,05	-0,12	0,05	-0,06	-0,08	-0,02	0,13	**1,00**	0,48
JB1	-0,27	0,23	0,12	0,18	0,26	0,07	0,09	0,08	0,06	0,01	0,13	0,48	**1,00**

2. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,31	0,09	0,12	0,00	0,45	-0,11	0,00	0,00	0,00	0,12	0,00	0,00
TU1	-0,31	**1,00**	0,71	-0,02	0,00	-0,28	0,36	0,00	0,00	0,00	-0,25	0,00	0,00
FV1	0,09	0,71	**1,00**	0,00	0,00	-0,01	0,08	0,00	0,00	0,00	-0,12	0,00	0,00
TY1	0,12	-0,02	0,00	**1,00**	0,00	0,12	0,00	0,00	0,00	0,00	0,06	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ER1	0,45	-0,28	-0,01	0,12	0,00	**1,00**	-0,35	0,00	0,00	0,00	0,21	0,00	0,00
DU1	-0,11	0,36	0,08	0,00	0,00	-0,35	**1,00**	0,00	0,00	0,00	-0,26	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
XM1	0,12	-0,25	-0,12	0,06	0,00	0,21	-0,26	0,00	0,00	0,00	**1,00**	0,00	0,00
YE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,66	-0,86	-0,82	-0,75	-0,46	-0,67	-0,67	-0,63	-0,59	-0,21	-0,11	0,17
TU1	-0,66	**1,00**	0,66	0,66	0,60	0,30	0,47	0,47	0,46	0,46	0,06	0,17	-0,08
FV1	-0,86	0,66	**1,00**	0,98	0,92	0,35	0,64	0,70	0,72	0,71	0,26	0,12	-0,06
TY1	-0,82	0,66	0,98	**1,00**	0,97	0,33	0,63	0,70	0,73	0,72	0,23	0,10	-0,03
US1	-0,75	0,60	0,92	0,97	**1,00**	0,24	0,54	0,62	0,67	0,68	0,13	0,05	-0,05
ER1	-0,46	0,30	0,35	0,33	0,24	**1,00**	0,80	0,68	0,56	0,40	0,40	0,14	0,08
DU1	-0,67	0,47	0,64	0,63	0,54	0,80	**1,00**	0,96	0,89	0,77	0,42	0,18	0,14
OE1	-0,67	0,47	0,70	0,70	0,62	0,68	0,96	**1,00**	0,97	0,88	0,43	0,18	0,18
RX1	-0,63	0,46	0,72	0,73	0,67	0,56	0,89	0,97	**1,00**	0,96	0,40	0,16	0,17
UB1	-0,59	0,46	0,71	0,72	0,68	0,40	0,77	0,88	0,96	**1,00**	0,31	0,11	0,11
XM1	-0,21	0,06	0,26	0,23	0,13	0,40	0,42	0,43	0,40	0,31	**1,00**	0,03	0,14
YE1	-0,11	0,17	0,12	0,10	0,05	0,14	0,18	0,18	0,16	0,11	0,03	**1,00**	0,27
JB1	0,17	-0,08	-0,06	-0,03	-0,05	0,08	0,14	0,18	0,17	0,11	0,14	0,27	**1,00**

CSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,29	0,00	0,00	0,00	0,00	0,00	0,00	-0,64	-0,59	-0,21	-0,20	0,00
TU1	0,29	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	-0,16	-0,14	-0,14	-0,03	0,00
FV1	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
TY1	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ER1	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	-0,64	-0,16	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,96	0,38	0,15	0,00
UB1	-0,59	-0,14	0,00	0,00	0,00	0,00	0,00	0,00	0,96	**1,00**	0,29	0,09	0,00
XM1	-0,21	-0,14	0,00	0,00	0,00	0,00	0,00	0,00	0,38	0,29	**1,00**	-0,01	0,00
YE1	-0,20	-0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,15	0,09	-0,01	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,32	0,25	0,16	0,19	-0,15	-0,11	0,19	0,01	0,08	0,14	-0,04	0,09
TU1	0,32	**1,00**	0,90	0,59	0,45	-0,17	0,07	0,39	-0,15	-0,26	0,02	-0,11	0,07
FV1	0,25	0,90	**1,00**	0,68	0,54	-0,16	0,07	0,47	-0,20	-0,24	0,01	-0,18	0,19
TY1	0,16	0,59	0,68	**1,00**	0,90	-0,07	-0,01	0,39	-0,02	-0,07	0,05	-0,17	0,21
US1	0,19	0,45	0,54	0,90	**1,00**	-0,05	-0,07	0,26	-0,10	-0,03	0,11	-0,20	0,17
ER1	-0,15	-0,17	-0,16	-0,07	-0,05	**1,00**	0,22	0,19	-0,06	0,17	-0,02	-0,13	0,12
DU1	-0,11	0,07	0,07	-0,01	-0,07	0,22	**1,00**	0,53	-0,10	-0,01	0,34	0,01	-0,04
OE1	0,19	0,39	0,47	0,39	0,26	0,19	0,53	**1,00**	0,01	0,02	0,26	-0,14	0,15
RX1	0,01	-0,15	-0,20	-0,02	-0,10	-0,06	-0,10	0,01	**1,00**	0,68	0,12	0,11	-0,11
UB1	0,08	-0,26	-0,24	-0,07	-0,03	0,17	-0,01	0,02	0,68	**1,00**	0,19	0,09	0,01
XM1	0,14	0,02	0,01	0,05	0,11	-0,02	0,34	0,26	0,12	0,19	**1,00**	0,07	0,04
YE1	-0,04	-0,11	-0,18	-0,17	-0,20	-0,13	0,01	-0,14	0,11	0,09	0,07	**1,00**	0,04
JB1	0,09	0,07	0,19	0,21	0,17	0,12	-0,04	0,15	-0,11	0,01	0,04	0,04	**1,00**

CSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,05	0,00	-0,02	-0,10	0,03	-0,02	-0,14	-0,25	0,13	-0,09	0,24	0,05
TU1	0,05	**1,00**	0,43	0,37	-0,02	0,01	-0,06	-0,02	-0,23	-0,11	-0,21	-0,13	0,13
FV1	0,00	0,43	**1,00**	0,52	0,09	-0,13	-0,62	-0,12	-0,17	0,01	-0,04	-0,04	0,19
TY1	-0,02	0,37	0,52	**1,00**	0,41	-0,27	-0,08	-0,11	-0,23	0,07	0,11	-0,02	0,16
US1	-0,10	-0,02	0,09	0,41	**1,00**	-0,22	-0,07	-0,21	-0,07	0,06	0,12	-0,03	0,21
ER1	0,03	0,01	-0,13	-0,27	-0,22	**1,00**	-0,14	-0,19	-0,06	0,10	0,00	-0,22	-0,02
DU1	-0,02	-0,06	-0,62	-0,08	-0,07	-0,14	**1,00**	0,55	0,17	0,10	0,07	0,23	-0,10
OE1	-0,14	-0,02	-0,12	-0,11	-0,21	-0,19	0,55	**1,00**	0,29	0,04	-0,05	0,26	-0,09
RX1	-0,25	-0,23	-0,17	-0,23	-0,07	-0,06	0,17	0,29	**1,00**	0,00	-0,01	0,02	-0,03
UB1	0,13	-0,11	0,01	0,07	0,06	0,10	0,10	0,04	0,00	**1,00**	0,17	0,03	-0,10
XM1	-0,09	-0,21	-0,04	0,11	0,12	0,00	0,07	-0,05	-0,01	0,17	**1,00**	0,06	0,01
YE1	0,24	-0,13	-0,04	-0,02	-0,03	-0,22	0,23	0,26	0,02	0,03	0,06	**1,00**	0,35
JB1	0,05	0,13	0,19	0,16	0,21	-0,02	-0,10	-0,09	-0,03	-0,10	0,01	0,35	**1,00**

B&H	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,67	0,86	0,82	0,75	0,46	0,67	0,67	0,63	0,59	0,21	-0,10	-0,17
TU1	0,67	**1,00**	0,64	0,63	0,54	0,80	1,00	0,96	0,89	0,77	0,42	-0,02	0,14
FV1	0,86	0,64	**1,00**	0,98	0,92	0,35	0,64	0,70	0,72	0,71	0,26	-0,01	-0,06
TY1	0,82	0,63	0,98	**1,00**	0,97	0,33	0,63	0,70	0,73	0,72	0,23	0,00	-0,03
US1	0,75	0,54	0,92	0,97	**1,00**	0,24	0,54	0,62	0,67	0,68	0,13	-0,04	-0,05
ER1	0,46	0,80	0,35	0,33	0,24	**1,00**	0,80	0,68	0,56	0,40	0,40	-0,04	0,08
DU1	0,67	1,00	0,64	0,63	0,54	0,80	**1,00**	0,96	0,89	0,77	0,42	-0,02	0,14
OE1	0,67	0,96	0,70	0,70	0,62	0,68	0,96	**1,00**	0,97	0,88	0,43	-0,01	0,18
RX1	0,63	0,89	0,72	0,73	0,67	0,56	0,89	0,97	**1,00**	0,96	0,40	-0,01	0,17
UB1	0,59	0,77	0,71	0,72	0,68	0,40	0,77	0,88	0,96	**1,00**	0,31	0,01	0,11
XM1	0,21	0,42	0,26	0,23	0,13	0,40	0,42	0,43	0,40	0,31	**1,00**	0,04	0,14
YE1	-0,10	-0,02	-0,01	0,00	-0,04	-0,04	-0,02	-0,01	-0,01	0,01	0,04	**1,00**	0,57
JB1	-0,17	0,14	-0,06	-0,03	-0,05	0,08	0,14	0,18	0,17	0,11	0,14	0,57	**1,00**

Table 53: Portfolio Correlations -17.03.2004-14.06.2004 (Bloomberg L.P. 2017, own graph)

TSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,93	0,89	0,85	0,76	0,50	0,78	0,79	0,79	0,68	0,19	0,03	0,09
TU1	0,93	**1,00**	0,97	0,94	0,87	0,50	0,74	0,77	0,78	0,67	0,26	0,14	0,20
FV1	0,89	0,97	**1,00**	0,99	0,95	0,49	0,74	0,79	0,81	0,71	0,30	0,06	0,14
TY1	0,85	0,94	0,99	**1,00**	0,97	0,46	0,73	0,79	0,81	0,72	0,31	0,04	0,11
US1	0,76	0,87	0,95	0,97	**1,00**	0,40	0,68	0,74	0,76	0,70	0,37	0,05	0,14
ER1	0,50	0,50	0,49	0,46	0,40	**1,00**	0,76	0,68	0,61	0,47	0,08	0,01	0,26
DU1	0,78	0,74	0,74	0,73	0,68	0,76	**1,00**	0,97	0,92	0,76	0,17	-0,05	0,18
OE1	0,79	0,77	0,79	0,79	0,74	0,68	0,97	**1,00**	0,97	0,83	0,26	-0,03	0,16
RX1	0,79	0,78	0,81	0,81	0,76	0,61	0,92	0,97	**1,00**	0,88	0,30	-0,01	0,15
UB1	0,68	0,67	0,71	0,72	0,70	0,47	0,76	0,83	0,88	**1,00**	0,34	-0,14	0,02
XM1	0,19	0,26	0,30	0,31	0,37	0,08	0,17	0,26	0,30	0,34	**1,00**	0,14	0,32
YE1	0,03	0,14	0,06	0,04	0,05	0,01	-0,05	-0,03	-0,01	-0,14	0,14	**1,00**	0,43
JB1	0,09	0,20	0,14	0,11	0,14	0,26	0,18	0,16	0,15	0,02	0,32	0,43	**1,00**

1. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,90	0,88	0,83	0,72	0,51	-0,40	-0,30	0,77	0,71	0,23	0,02	0,07
TU1	0,90	**1,00**	0,93	0,89	0,83	0,42	-0,19	-0,10	0,60	0,58	0,24	0,17	0,17
FV1	0,88	0,93	**1,00**	0,99	0,92	0,46	-0,37	-0,30	0,73	0,71	0,34	0,09	0,21
TY1	0,83	0,89	0,99	**1,00**	0,96	0,43	-0,36	-0,30	0,72	0,72	0,35	0,08	0,24
US1	0,72	0,83	0,92	0,96	**1,00**	0,31	-0,23	-0,16	0,60	0,62	0,39	0,11	0,30
ER1	0,51	0,42	0,46	0,43	0,31	**1,00**	-0,64	-0,51	0,63	0,56	0,15	-0,03	-0,04
DU1	-0,40	-0,19	-0,37	-0,36	-0,23	-0,64	**1,00**	0,94	-0,72	-0,63	-0,12	0,10	-0,07
OE1	-0,30	-0,10	-0,30	-0,30	-0,16	-0,51	0,94	**1,00**	-0,67	-0,59	-0,26	0,04	-0,09
RX1	0,77	0,60	0,73	0,72	0,60	0,63	-0,72	-0,67	**1,00**	0,92	0,35	-0,04	0,09
UB1	0,71	0,58	0,71	0,72	0,62	0,56	-0,63	-0,59	0,92	**1,00**	0,40	-0,09	0,13
XM1	0,23	0,24	0,34	0,35	0,39	0,15	-0,12	-0,26	0,35	0,40	**1,00**	0,22	0,53
YE1	0,02	0,17	0,09	0,08	0,11	-0,03	0,10	0,04	-0,04	-0,09	0,22	**1,00**	0,46
JB1	0,07	0,17	0,21	0,24	0,30	-0,04	-0,07	-0,09	0,09	0,13	0,53	0,46	**1,00**

2. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,67	0,38	0,00	0,00	0,48	0,00	0,00	0,00	0,00	0,37	0,00	0,00
TU1	0,67	**1,00**	-0,04	0,00	0,00	0,19	0,00	0,00	0,00	0,00	-0,02	0,00	0,00
FV1	0,38	-0,04	**1,00**	0,00	0,00	0,21	0,00	0,00	0,00	0,00	-0,03	0,00	0,00
TY1	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ER1	0,48	0,19	0,21	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,46	0,00	0,00
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
XM1	0,37	-0,02	-0,03	0,00	0,00	0,46	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00
YE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,50	-0,89	-0,85	-0,76	-0,50	-0,78	-0,79	-0,79	-0,68	-0,19	0,03	-0,05
TU1	-0,50	**1,00**	0,39	0,33	0,30	0,01	0,16	0,15	0,19	0,25	0,12	-0,14	0,05
FV1	-0,89	0,39	**1,00**	0,99	0,95	0,49	0,75	0,79	0,81	0,71	0,30	-0,06	0,16
TY1	-0,85	0,33	0,99	**1,00**	0,97	0,46	0,74	0,79	0,81	0,72	0,31	-0,04	0,18
US1	-0,76	0,30	0,95	0,97	**1,00**	0,40	0,68	0,74	0,76	0,70	0,37	-0,05	0,23
ER1	-0,50	0,01	0,49	0,46	0,40	**1,00**	0,75	0,68	0,61	0,47	0,08	-0,01	-0,05
DU1	-0,78	0,16	0,75	0,74	0,68	0,75	**1,00**	0,97	0,92	0,77	0,18	0,06	-0,01
OE1	-0,79	0,15	0,79	0,79	0,74	0,68	0,97	**1,00**	0,97	0,83	0,26	0,03	0,06
RX1	-0,79	0,19	0,81	0,81	0,76	0,61	0,92	0,97	**1,00**	0,88	0,30	0,01	0,11
UB1	-0,68	0,25	0,71	0,72	0,70	0,47	0,77	0,83	0,88	**1,00**	0,34	0,14	0,13
XM1	-0,19	0,12	0,30	0,31	0,37	0,08	0,18	0,26	0,30	0,34	**1,00**	-0,14	0,49
YE1	0,03	-0,14	-0,06	-0,04	-0,05	-0,01	0,06	0,03	0,01	0,14	-0,14	**1,00**	-0,46
JB1	-0,05	0,05	0,16	0,18	0,23	-0,05	-0,01	0,06	0,11	0,13	0,49	-0,46	**1,00**

CSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,38	0,00	0,00	-0,33	0,00	0,00	0,00	-0,70	-0,67	-0,19	0,03	0,00
TU1	0,38	**1,00**	0,00	0,00	-0,92	0,00	0,00	0,00	0,02	-0,38	-0,12	-0,01	0,00
FV1	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
TY1	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
US1	-0,33	-0,92	0,00	0,00	**1,00**	0,00	0,00	0,00	-0,03	0,40	0,32	-0,03	0,00
ER1	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	-0,70	0,02	0,00	0,00	-0,03	0,00	0,00	0,00	**1,00**	0,73	0,16	0,04	0,00
UB1	-0,67	-0,38	0,00	0,00	0,40	0,00	0,00	0,00	0,73	**1,00**	0,32	0,17	0,00
XM1	-0,19	-0,12	0,00	0,00	0,32	0,00	0,00	0,00	0,16	0,32	**1,00**	-0,14	0,00
YE1	0,03	-0,01	0,00	0,00	-0,03	0,00	0,00	0,00	0,04	0,17	-0,14	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,65	0,60	0,48	0,46	0,19	-0,07	0,38	-0,26	-0,24	-0,10	0,27	0,26
TU1	0,65	**1,00**	0,89	0,68	0,62	0,08	-0,03	0,40	-0,23	-0,14	-0,19	0,19	0,26
FV1	0,60	0,89	**1,00**	0,83	0,79	0,11	-0,11	0,38	-0,22	-0,15	-0,21	0,12	0,12
TY1	0,48	0,68	0,83	**1,00**	0,97	0,07	-0,08	0,43	-0,18	-0,11	-0,13	0,00	0,05
US1	0,46	0,62	0,79	0,97	**1,00**	0,08	-0,03	0,44	-0,20	-0,08	-0,11	0,03	0,03
ER1	0,19	0,08	0,11	0,07	0,08	**1,00**	0,06	0,48	0,20	0,15	0,02	0,13	0,09
DU1	-0,07	-0,03	-0,11	-0,08	-0,03	0,06	**1,00**	0,33	-0,13	-0,10	0,13	-0,02	0,19
OE1	0,38	0,40	0,38	0,43	0,44	0,48	0,33	**1,00**	-0,03	0,00	-0,10	-0,04	0,15
RX1	-0,26	-0,23	-0,22	-0,18	-0,20	0,20	-0,13	-0,03	**1,00**	0,72	0,10	-0,02	0,13
UB1	-0,24	-0,14	-0,15	-0,11	-0,08	0,15	-0,10	0,00	0,72	**1,00**	0,09	0,06	0,17
XM1	-0,10	-0,19	-0,21	-0,13	-0,11	0,02	0,13	-0,10	0,10	0,09	**1,00**	0,10	-0,08
YE1	0,27	0,19	0,12	0,00	0,03	0,13	-0,02	-0,04	-0,02	0,06	0,10	**1,00**	0,42
JB1	0,26	0,26	0,12	0,05	0,03	0,09	0,19	0,15	0,13	0,17	-0,08	0,42	**1,00**

CSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,02	0,11	-0,15	-0,25	-0,04	-0,02	-0,21	0,03	-0,11	0,01	0,23	0,06
TU1	0,02	**1,00**	0,85	0,65	-0,03	-0,02	-0,77	-0,11	0,04	0,13	-0,40	-0,08	-0,04
FV1	0,11	0,85	**1,00**	0,79	0,18	-0,02	-0,75	-0,13	-0,04	0,05	-0,28	0,00	-0,03
TY1	-0,15	0,65	0,79	**1,00**	0,57	-0,18	-0,74	-0,20	-0,05	-0,04	-0,20	-0,06	0,03
US1	-0,25	-0,03	0,18	0,57	**1,00**	-0,29	-0,09	-0,28	-0,02	-0,07	0,00	-0,09	0,01
ER1	-0,04	-0,02	-0,02	-0,18	-0,29	**1,00**	0,03	0,20	-0,10	0,10	0,01	0,08	-0,06
DU1	-0,02	-0,77	-0,75	-0,74	-0,09	0,03	**1,00**	0,29	0,16	-0,01	0,35	0,06	0,02
OE1	-0,21	-0,11	-0,13	-0,20	-0,28	0,20	0,29	**1,00**	0,19	0,18	-0,16	-0,17	0,08
RX1	0,03	0,04	-0,04	-0,05	-0,02	-0,10	0,16	0,19	**1,00**	0,11	-0,07	-0,02	-0,08
UB1	-0,11	0,13	0,05	-0,04	-0,07	0,10	-0,01	0,18	0,11	**1,00**	-0,09	-0,01	0,10
XM1	0,01	-0,40	-0,28	-0,20	0,00	0,01	0,35	-0,16	-0,07	-0,09	**1,00**	0,41	0,30
YE1	0,23	-0,08	0,00	-0,06	-0,09	0,08	0,06	-0,17	-0,02	-0,01	0,41	**1,00**	0,28
JB1	0,06	-0,04	-0,03	0,03	0,01	-0,06	0,02	0,08	-0,08	0,10	0,30	0,28	**1,00**

B&H	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,78	0,89	0,85	0,76	0,50	0,78	0,79	0,79	0,68	0,19	0,03	0,05
TU1	0,78	**1,00**	0,75	0,74	0,68	0,75	1,00	0,97	0,92	0,77	0,18	-0,06	-0,01
FV1	0,89	0,75	**1,00**	0,99	0,95	0,49	0,75	0,79	0,81	0,71	0,30	0,06	0,16
TY1	0,85	0,74	0,99	**1,00**	0,97	0,46	0,74	0,79	0,81	0,72	0,31	0,04	0,18
US1	0,76	0,68	0,95	0,97	**1,00**	0,40	0,68	0,74	0,76	0,70	0,37	0,05	0,23
ER1	0,50	0,75	0,49	0,46	0,40	**1,00**	0,75	0,68	0,61	0,47	0,08	0,01	-0,05
DU1	0,78	1,00	0,75	0,74	0,68	0,75	**1,00**	0,97	0,92	0,77	0,18	-0,06	-0,01
OE1	0,79	0,97	0,79	0,79	0,74	0,68	0,97	**1,00**	0,97	0,83	0,26	-0,03	0,06
RX1	0,79	0,92	0,81	0,81	0,76	0,61	0,92	0,97	**1,00**	0,88	0,30	-0,01	0,11
UB1	0,68	0,77	0,71	0,72	0,70	0,47	0,77	0,83	0,88	**1,00**	0,34	-0,14	0,13
XM1	0,19	0,18	0,30	0,31	0,37	0,08	0,18	0,26	0,30	0,34	**1,00**	0,14	0,49
YE1	0,03	-0,06	0,06	0,04	0,05	0,01	-0,06	-0,03	-0,01	-0,14	0,14	**1,00**	0,46
JB1	0,05	-0,01	0,16	0,18	0,23	-0,05	-0,01	0,06	0,11	0,13	0,49	0,46	**1,00**

Table 54: Portfolio Correlations - 28.06.2005-14.11.2005 (Bloomberg L.P., 2017, own graph)

TSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,54	0,82	0,74	0,63	0,40	0,54	0,54	0,49	0,39	0,13	0,13	0,08
TU1	0,54	**1,00**	0,64	0,61	0,57	0,72	1,00	0,94	0,85	0,73	0,12	0,13	0,13
FV1	0,82	0,64	**1,00**	0,97	0,92	0,39	0,64	0,66	0,63	0,56	0,05	0,06	0,05
TY1	0,74	0,61	0,97	**1,00**	0,96	0,36	0,61	0,66	0,64	0,58	0,05	0,05	0,03
US1	0,63	0,57	0,92	0,96	**1,00**	0,32	0,57	0,63	0,62	0,59	0,07	0,01	0,00
ER1	0,40	0,72	0,39	0,36	0,32	**1,00**	0,72	0,64	0,57	0,45	0,16	0,18	0,20
DU1	0,54	1,00	0,64	0,61	0,57	0,72	**1,00**	0,94	0,85	0,73	0,12	0,13	0,13
OE1	0,54	0,94	0,66	0,66	0,63	0,64	0,94	**1,00**	0,96	0,85	0,20	0,13	0,15
RX1	0,49	0,85	0,63	0,64	0,62	0,57	0,85	0,96	**1,00**	0,93	0,24	0,16	0,17
UB1	0,39	0,73	0,56	0,58	0,59	0,45	0,73	0,85	0,93	**1,00**	0,22	0,18	0,15
XM1	0,13	0,12	0,05	0,05	0,07	0,16	0,12	0,20	0,24	0,22	**1,00**	0,41	0,45
YE1	0,13	0,13	0,06	0,05	0,01	0,18	0,13	0,13	0,16	0,18	0,41	**1,00**	0,77
JB1	0,08	0,13	0,05	0,03	0,00	0,20	0,13	0,15	0,17	0,15	0,45	0,77	**1,00**

1. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,93	0,81	0,75	0,64	0,40	-0,12	0,35	0,48	0,36	0,15	0,14	0,08
TU1	0,93	**1,00**	0,93	0,87	0,75	0,41	-0,06	0,47	0,55	0,45	0,05	0,11	0,09
FV1	0,81	0,93	**1,00**	0,97	0,91	0,39	-0,03	0,51	0,61	0,53	0,05	0,08	0,05
TY1	0,75	0,87	0,97	**1,00**	0,96	0,36	-0,06	0,50	0,64	0,58	0,07	0,07	0,03
US1	0,64	0,75	0,91	0,96	**1,00**	0,32	-0,02	0,45	0,62	0,57	0,11	0,04	0,00
ER1	0,40	0,41	0,39	0,36	0,32	**1,00**	0,11	0,51	0,55	0,43	0,19	0,19	0,22
DU1	-0,12	-0,06	-0,03	-0,06	-0,02	0,11	**1,00**	0,39	0,10	0,08	0,01	-0,09	-0,08
OE1	0,35	0,47	0,51	0,50	0,45	0,51	0,39	**1,00**	0,70	0,60	0,02	0,01	0,03
RX1	0,48	0,55	0,61	0,64	0,62	0,55	0,10	0,70	**1,00**	0,92	0,25	0,17	0,20
UB1	0,36	0,45	0,53	0,58	0,57	0,43	0,08	0,60	0,92	**1,00**	0,22	0,17	0,18
XM1	0,15	0,05	0,05	0,07	0,11	0,19	0,01	0,02	0,25	0,22	**1,00**	0,40	0,46
YE1	0,14	0,11	0,08	0,07	0,04	0,19	-0,09	0,01	0,17	0,17	0,40	**1,00**	0,75
JB1	0,08	0,09	0,05	0,03	0,00	0,22	-0,08	0,03	0,20	0,18	0,46	0,75	**1,00**

2. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,76	0,40	0,00	0,00	0,40	-0,14	0,00	0,00	0,00	0,09	0,00	0,00
TU1	0,76	**1,00**	-0,02	0,00	0,00	0,30	-0,22	0,00	0,00	0,00	0,00	0,00	0,00
FV1	0,40	-0,02	**1,00**	0,00	0,00	0,30	0,02	0,00	0,00	0,00	0,00	0,00	0,00
TY1	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ER1	0,40	0,30	0,30	0,00	0,00	**1,00**	-0,12	0,00	0,00	0,00	0,09	0,00	0,00
DU1	-0,14	-0,22	0,02	0,00	0,00	-0,12	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
XM1	0,09	0,00	0,00	0,00	0,00	0,09	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00
YE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,94	0,82	0,74	0,63	0,40	0,54	0,54	0,49	0,39	0,13	-0,08	0,08
TU1	0,94	**1,00**	0,94	0,88	0,78	0,42	0,62	0,63	0,59	0,50	0,08	-0,05	0,08
FV1	0,82	0,94	**1,00**	0,97	0,92	0,39	0,64	0,66	0,63	0,56	0,05	-0,02	0,05
TY1	0,74	0,88	0,97	**1,00**	0,96	0,36	0,61	0,66	0,64	0,58	0,05	0,00	0,03
US1	0,63	0,78	0,92	0,96	**1,00**	0,32	0,57	0,63	0,62	0,59	0,07	0,03	0,00
ER1	0,40	0,42	0,39	0,36	0,32	**1,00**	0,72	0,64	0,57	0,45	0,16	-0,17	0,20
DU1	0,54	0,62	0,64	0,61	0,57	0,72	**1,00**	0,94	0,85	0,73	0,12	-0,10	0,13
OE1	0,54	0,63	0,66	0,66	0,63	0,64	0,94	**1,00**	0,96	0,85	0,20	-0,11	0,15
RX1	0,49	0,59	0,63	0,64	0,62	0,57	0,85	0,96	**1,00**	0,93	0,24	-0,15	0,17
UB1	0,39	0,50	0,56	0,58	0,59	0,45	0,73	0,85	0,93	**1,00**	0,22	-0,15	0,15
XM1	0,13	0,08	0,05	0,05	0,07	0,16	0,12	0,20	0,24	0,22	**1,00**	-0,43	0,45
YE1	-0,08	-0,05	-0,02	0,00	0,03	-0,17	-0,10	-0,11	-0,15	-0,15	-0,43	**1,00**	-0,77
JB1	0,08	0,08	0,05	0,03	0,00	0,20	0,13	0,15	0,17	0,15	0,45	-0,77	**1,00**

CSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
TU1	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FV1	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
TY1	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	-0,01	0,51	0,09	0,00	0,00
ER1	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	-0,01	0,00	0,00	0,00	**1,00**	0,38	0,06	-0,01	0,00
UB1	0,00	0,00	0,00	0,00	0,51	0,00	0,00	0,00	0,38	**1,00**	0,22	-0,17	0,00
XM1	0,00	0,00	0,00	0,00	0,09	0,00	0,00	0,00	0,06	0,22	**1,00**	-0,42	0,00
YE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,17	-0,42	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,07	-0,16	-0,17	-0,11	0,29	0,11	0,01	-0,29	-0,29	0,06	-0,08	-0,03
TU1	-0,07	**1,00**	0,82	0,74	0,64	-0,16	0,10	0,15	0,00	0,03	-0,03	0,10	0,16
FV1	-0,16	0,82	**1,00**	0,95	0,78	-0,21	0,16	0,19	0,01	0,05	-0,03	0,04	0,15
TY1	-0,17	0,74	0,95	**1,00**	0,84	-0,21	0,15	0,19	0,00	0,04	-0,04	0,01	0,11
US1	-0,11	0,64	0,78	0,84	**1,00**	-0,13	0,15	0,11	0,01	0,05	-0,07	0,05	0,19
ER1	0,29	-0,16	-0,21	-0,21	-0,13	**1,00**	0,15	0,17	-0,21	-0,26	0,07	0,09	-0,02
DU1	0,11	0,10	0,16	0,15	0,15	0,15	**1,00**	0,65	-0,04	0,05	0,10	-0,10	0,12
OE1	0,01	0,15	0,19	0,19	0,11	0,17	0,65	**1,00**	-0,09	-0,08	-0,03	-0,04	0,00
RX1	-0,29	0,00	0,01	0,00	0,01	-0,21	-0,04	-0,09	**1,00**	0,84	0,04	0,03	-0,07
UB1	-0,29	0,03	0,05	0,04	0,05	-0,26	0,05	-0,08	0,84	**1,00**	0,06	0,00	0,03
XM1	0,06	-0,03	-0,03	-0,04	-0,07	0,07	0,10	-0,03	0,04	0,06	**1,00**	-0,28	0,03
YE1	-0,08	0,10	0,04	0,01	0,05	0,09	-0,10	-0,04	0,03	0,00	-0,28	**1,00**	0,12
JB1	-0,03	0,16	0,15	0,11	0,19	-0,02	0,12	0,00	-0,07	0,03	0,03	0,12	**1,00**

CSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,28	-0,33	-0,36	-0,26	0,23	-0,03	0,01	-0,31	0,08	0,13	0,00	-0,06
TU1	-0,28	**1,00**	0,70	0,24	-0,04	-0,11	0,08	-0,03	-0,05	-0,01	0,06	0,04	0,04
FV1	-0,33	0,70	**1,00**	0,61	0,30	-0,16	0,02	-0,09	0,01	-0,10	-0,02	0,14	0,08
TY1	-0,36	0,24	0,61	**1,00**	0,52	-0,23	-0,03	-0,13	-0,04	-0,09	-0,13	0,02	-0,02
US1	-0,26	-0,04	0,30	0,52	**1,00**	-0,16	-0,11	-0,34	0,19	-0,03	-0,04	0,03	-0,03
ER1	0,23	-0,11	-0,16	-0,23	-0,16	**1,00**	0,15	-0,05	-0,14	0,06	0,00	0,08	-0,16
DU1	-0,03	0,08	0,02	-0,03	-0,11	0,15	**1,00**	0,25	-0,01	-0,08	-0,09	-0,06	0,06
OE1	0,01	-0,03	-0,09	-0,13	-0,34	-0,05	0,25	**1,00**	0,21	0,00	-0,03	0,04	0,02
RX1	-0,31	-0,05	0,01	-0,04	0,19	-0,14	-0,01	0,21	**1,00**	-0,06	0,00	-0,11	-0,02
UB1	0,08	-0,01	-0,10	-0,09	-0,03	0,06	-0,08	0,00	-0,06	**1,00**	0,03	0,09	-0,10
XM1	0,13	0,06	-0,02	-0,13	-0,04	0,00	-0,09	-0,03	0,00	0,03	**1,00**	-0,15	-0,05
YE1	0,00	0,04	0,14	0,02	0,03	0,08	-0,06	0,04	-0,11	0,09	-0,15	**1,00**	0,57
JB1	-0,06	0,04	0,08	-0,02	-0,03	-0,16	0,06	0,02	-0,02	-0,10	-0,05	0,57	**1,00**

B&H	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,54	0,82	0,74	0,63	0,40	0,54	0,54	0,49	0,39	0,13	0,13	0,08
TU1	0,54	**1,00**	0,64	0,61	0,57	0,72	1,00	0,94	0,85	0,73	0,12	0,13	0,13
FV1	0,82	0,64	**1,00**	0,97	0,92	0,39	0,64	0,66	0,63	0,56	0,05	0,06	0,05
TY1	0,74	0,61	0,97	**1,00**	0,96	0,36	0,61	0,66	0,64	0,58	0,05	0,05	0,03
US1	0,63	0,57	0,92	0,96	**1,00**	0,32	0,57	0,63	0,62	0,59	0,07	0,01	0,00
ER1	0,40	0,72	0,39	0,36	0,32	**1,00**	0,72	0,64	0,57	0,45	0,16	0,18	0,20
DU1	0,54	1,00	0,64	0,61	0,57	0,72	**1,00**	0,94	0,85	0,73	0,12	0,13	0,13
OE1	0,54	0,94	0,66	0,66	0,63	0,64	0,94	**1,00**	0,96	0,85	0,20	0,13	0,15
RX1	0,49	0,85	0,63	0,64	0,62	0,57	0,85	0,96	**1,00**	0,93	0,24	0,16	0,17
UB1	0,39	0,73	0,56	0,58	0,59	0,45	0,73	0,85	0,93	**1,00**	0,22	0,18	0,15
XM1	0,13	0,12	0,05	0,05	0,07	0,16	0,12	0,20	0,24	0,22	**1,00**	0,41	0,45
YE1	0,13	0,13	0,06	0,05	0,01	0,18	0,13	0,13	0,16	0,18	0,41	**1,00**	0,77
JB1	0,08	0,13	0,05	0,03	0,00	0,20	0,13	0,15	0,17	0,15	0,45	0,77	**1,00**

Table 55: Portfolio Correlations - 01.06.2005-01.06.2006 (Bloomberg L.P., 2017, own graph)

TSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,57	0,50	0,52	0,47	0,33	0,40	0,50	0,48	0,41	0,09	0,13	-0,03
TU1	0,57	**1,00**	0,87	0,69	0,49	0,15	0,16	0,26	0,24	0,19	0,02	0,02	-0,13
FV1	0,50	0,87	**1,00**	0,78	0,59	0,16	0,15	0,27	0,27	0,24	0,06	0,04	-0,16
TY1	0,52	0,69	0,78	**1,00**	0,84	0,27	0,23	0,38	0,38	0,34	0,04	0,00	-0,06
US1	0,47	0,49	0,59	0,84	**1,00**	0,27	0,25	0,41	0,42	0,40	0,09	-0,02	-0,08
ER1	0,33	0,15	0,16	0,27	0,27	**1,00**	0,70	0,67	0,58	0,44	0,01	-0,01	-0,04
DU1	0,40	0,16	0,15	0,23	0,25	0,70	**1,00**	0,79	0,70	0,55	0,02	0,03	0,09
OE1	0,50	0,26	0,27	0,38	0,41	0,67	0,79	**1,00**	0,96	0,84	0,10	0,03	0,01
RX1	0,48	0,24	0,27	0,38	0,42	0,58	0,70	0,96	**1,00**	0,94	0,13	0,04	0,05
UB1	0,41	0,19	0,24	0,34	0,40	0,44	0,55	0,84	0,94	**1,00**	0,16	0,06	0,08
XM1	0,09	0,02	0,06	0,04	0,09	0,01	0,02	0,10	0,13	0,16	**1,00**	0,34	0,05
YE1	0,13	0,02	0,04	0,00	-0,02	-0,01	0,03	0,03	0,04	0,06	0,34	**1,00**	0,10
JB1	-0,03	-0,13	-0,16	-0,06	-0,08	-0,04	0,09	0,01	0,05	0,08	0,05	0,10	**1,00**

1. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,84	0,79	0,75	0,66	0,33	0,04	0,39	0,47	0,40	0,11	0,06	0,16
TU1	0,84	**1,00**	0,95	0,88	0,75	0,31	0,07	0,43	0,50	0,43	0,07	0,01	0,14
FV1	0,79	0,95	**1,00**	0,97	0,89	0,32	0,11	0,49	0,58	0,52	0,07	0,00	0,13
TY1	0,75	0,88	0,97	**1,00**	0,95	0,32	0,11	0,51	0,61	0,56	0,09	0,00	0,13
US1	0,66	0,75	0,89	0,95	**1,00**	0,30	0,14	0,50	0,60	0,56	0,12	0,01	0,12
ER1	0,33	0,31	0,32	0,32	0,30	**1,00**	0,37	0,63	0,54	0,40	0,04	-0,07	0,09
DU1	0,04	0,07	0,11	0,11	0,14	0,37	**1,00**	0,56	0,34	0,25	0,01	-0,01	-0,01
OE1	0,39	0,43	0,49	0,51	0,50	0,63	0,56	**1,00**	0,83	0,69	0,04	-0,03	0,09
RX1	0,47	0,50	0,58	0,61	0,60	0,54	0,34	0,83	**1,00**	0,93	0,17	-0,01	0,16
UB1	0,40	0,43	0,52	0,56	0,56	0,40	0,25	0,69	0,93	**1,00**	0,18	0,01	0,15
XM1	0,11	0,07	0,07	0,09	0,12	0,04	0,01	0,04	0,17	0,18	**1,00**	0,22	0,38
YE1	0,06	0,01	0,00	0,00	0,01	-0,07	-0,01	-0,03	-0,01	0,01	0,22	**1,00**	0,38
JB1	0,16	0,14	0,13	0,13	0,12	0,09	-0,01	0,09	0,16	0,15	0,38	0,38	**1,00**

2. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,44	0,55	-0,29	-0,14	0,32	-0,10	0,00	0,00	0,00	0,05	-0,01	0,00
TU1	0,44	**1,00**	0,19	0,02	0,00	0,14	-0,17	0,00	0,00	0,00	-0,03	0,00	0,00
FV1	0,55	0,19	**1,00**	-0,36	-0,13	0,21	0,00	0,00	0,00	0,00	-0,02	0,00	0,00
TY1	-0,29	0,02	-0,36	**1,00**	0,46	-0,05	-0,01	0,00	0,00	0,00	0,01	0,05	0,00
US1	-0,14	0,00	-0,13	0,46	**1,00**	-0,13	-0,01	0,00	0,00	0,00	-0,06	0,02	0,00
ER1	0,32	0,14	0,21	-0,05	-0,13	**1,00**	-0,11	0,00	0,00	0,00	0,05	0,02	0,00
DU1	-0,10	-0,17	0,00	-0,01	-0,01	-0,11	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
XM1	0,05	-0,03	-0,02	0,01	-0,06	0,05	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00
YE1	-0,01	0,00	0,00	0,05	0,02	0,02	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,89	0,82	0,76	0,65	0,33	0,46	0,50	0,48	0,41	0,09	-0,08	0,16
TU1	0,89	**1,00**	0,95	0,90	0,80	0,34	0,49	0,55	0,53	0,45	0,09	-0,04	0,16
FV1	0,82	0,95	**1,00**	0,98	0,92	0,34	0,52	0,60	0,60	0,54	0,08	-0,04	0,14
TY1	0,76	0,90	0,98	**1,00**	0,96	0,33	0,52	0,61	0,62	0,57	0,08	-0,05	0,13
US1	0,65	0,80	0,92	0,96	**1,00**	0,29	0,49	0,59	0,62	0,59	0,11	-0,04	0,11
ER1	0,33	0,34	0,34	0,33	0,29	**1,00**	0,76	0,67	0,58	0,44	0,01	-0,11	0,06
DU1	0,46	0,49	0,52	0,52	0,49	0,76	**1,00**	0,94	0,85	0,70	0,04	-0,08	0,11
OE1	0,50	0,55	0,60	0,61	0,59	0,67	0,94	**1,00**	0,96	0,84	0,10	-0,08	0,14
RX1	0,48	0,53	0,60	0,62	0,62	0,58	0,85	0,96	**1,00**	0,94	0,13	-0,08	0,15
UB1	0,41	0,45	0,54	0,57	0,59	0,44	0,70	0,84	0,94	**1,00**	0,16	-0,06	0,15
XM1	0,09	0,09	0,08	0,08	0,11	0,01	0,04	0,10	0,13	0,16	**1,00**	-0,15	0,37
YE1	-0,08	-0,04	-0,04	-0,05	-0,04	-0,11	-0,08	-0,08	-0,08	-0,06	-0,15	**1,00**	-0,26
JB1	0,16	0,16	0,14	0,13	0,11	0,06	0,11	0,14	0,15	0,15	0,37	-0,26	**1,00**

CSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,42	-0,44	0,04	0,14	0,00	0,00	0,00	0,00	0,00	0,02	-0,05	0,00
TU1	0,42	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	-0,01	0,00
FV1	-0,44	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,03	-0,06	0,00
TY1	0,04	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	-0,08	-0,01	0,00
US1	0,14	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,37	0,06	-0,05	0,00
ER1	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,70	0,09	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,37	0,00	0,00	0,00	0,70	**1,00**	0,16	-0,08	0,00
XM1	0,02	0,01	-0,03	-0,08	0,06	0,00	0,00	0,00	0,09	0,16	**1,00**	-0,29	0,00
YE1	-0,05	-0,01	-0,06	-0,01	-0,05	0,00	0,00	0,00	0,00	-0,08	-0,29	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,08	0,03	0,02	0,01	0,22	0,07	0,06	-0,35	-0,33	0,06	-0,10	-0,04
TU1	0,08	**1,00**	0,84	0,72	0,60	-0,01	0,11	0,23	-0,06	-0,04	-0,01	0,02	0,10
FV1	0,03	0,84	**1,00**	0,90	0,76	-0,02	0,15	0,27	-0,07	-0,06	-0,07	0,00	0,07
TY1	0,02	0,72	0,90	**1,00**	0,87	-0,08	0,18	0,24	-0,07	-0,08	-0,02	0,00	0,05
US1	0,01	0,60	0,76	0,87	**1,00**	-0,06	0,19	0,22	-0,04	-0,05	-0,05	0,04	0,06
ER1	0,22	-0,01	-0,02	-0,08	-0,06	**1,00**	0,00	0,05	-0,20	-0,21	-0,03	-0,01	-0,06
DU1	0,07	0,11	0,15	0,18	0,19	0,00	**1,00**	0,70	-0,05	-0,02	-0,02	-0,07	0,03
OE1	0,06	0,23	0,27	0,24	0,22	0,05	0,70	**1,00**	-0,08	-0,08	-0,08	-0,06	-0,01
RX1	-0,35	-0,06	-0,07	-0,07	-0,04	-0,20	-0,05	-0,08	**1,00**	0,85	0,02	0,02	-0,05
UB1	-0,33	-0,04	-0,06	-0,08	-0,05	-0,21	-0,02	-0,08	0,85	**1,00**	0,03	0,03	0,06
XM1	0,06	-0,01	-0,07	-0,02	-0,05	-0,03	-0,02	-0,08	0,02	0,03	**1,00**	-0,09	0,07
YE1	-0,10	0,02	0,00	0,00	0,04	-0,01	-0,07	-0,06	0,02	0,03	-0,09	**1,00**	0,02
JB1	-0,04	0,10	0,07	0,05	0,06	-0,06	0,03	-0,01	-0,05	0,06	0,07	0,02	**1,00**

CSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,11	-0,32	-0,28	-0,27	0,12	0,01	-0,07	-0,19	-0,03	0,10	-0,02	0,00
TU1	-0,11	**1,00**	0,58	0,23	0,04	-0,10	0,02	-0,06	-0,13	0,07	0,04	0,07	0,05
FV1	-0,32	0,58	**1,00**	0,55	0,39	-0,09	-0,01	-0,01	-0,03	0,03	0,00	0,10	0,04
TY1	-0,28	0,23	0,55	**1,00**	0,44	-0,11	-0,11	-0,07	-0,05	0,04	-0,11	0,06	0,01
US1	-0,27	0,04	0,39	0,44	**1,00**	-0,18	-0,07	-0,15	0,11	-0,01	0,00	-0,02	-0,07
ER1	0,12	-0,10	-0,09	-0,11	-0,18	**1,00**	-0,11	-0,16	-0,25	-0,06	-0,02	0,04	0,04
DU1	0,01	0,02	-0,01	-0,11	-0,07	-0,11	**1,00**	0,50	0,24	0,00	0,02	-0,03	-0,05
OE1	-0,07	-0,06	-0,01	-0,07	-0,15	-0,16	0,50	**1,00**	0,44	-0,04	-0,10	-0,04	0,03
RX1	-0,19	-0,13	-0,03	-0,05	0,11	-0,25	0,24	0,44	**1,00**	0,00	-0,07	-0,07	-0,08
UB1	-0,03	0,07	0,03	0,04	-0,01	-0,06	0,00	-0,04	0,00	**1,00**	-0,06	0,07	-0,05
XM1	0,10	0,04	0,00	-0,11	0,00	-0,02	0,02	-0,10	-0,07	-0,06	**1,00**	-0,01	-0,02
YE1	-0,02	0,07	0,10	0,06	-0,02	0,04	-0,03	-0,04	-0,07	0,07	-0,01	**1,00**	0,30
JB1	0,00	0,05	0,04	0,01	-0,07	0,04	-0,05	0,03	-0,08	-0,05	-0,02	0,30	**1,00**

B&H	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,46	0,82	0,76	0,65	0,33	0,46	0,50	0,48	0,41	0,09	0,13	0,16
TU1	0,46	**1,00**	0,52	0,52	0,49	0,76	1,00	0,94	0,85	0,70	0,04	0,04	0,11
FV1	0,82	0,52	**1,00**	0,98	0,92	0,34	0,52	0,60	0,60	0,54	0,08	0,10	0,14
TY1	0,76	0,52	0,98	**1,00**	0,96	0,33	0,52	0,61	0,62	0,57	0,08	0,08	0,13
US1	0,65	0,49	0,92	0,96	**1,00**	0,29	0,49	0,59	0,62	0,59	0,11	0,05	0,11
ER1	0,33	0,76	0,34	0,33	0,29	**1,00**	0,76	0,67	0,58	0,44	0,01	-0,01	0,06
DU1	0,46	1,00	0,52	0,52	0,49	0,76	**1,00**	0,94	0,85	0,70	0,04	0,04	0,11
OE1	0,50	0,94	0,60	0,61	0,59	0,67	0,94	**1,00**	0,96	0,84	0,10	0,03	0,14
RX1	0,48	0,85	0,60	0,62	0,62	0,58	0,85	0,96	**1,00**	0,94	0,13	0,04	0,15
UB1	0,41	0,70	0,54	0,57	0,59	0,44	0,70	0,84	0,94	**1,00**	0,16	0,06	0,15
XM1	0,09	0,04	0,08	0,08	0,11	0,01	0,04	0,10	0,13	0,16	**1,00**	0,34	0,37
YE1	0,13	0,04	0,10	0,08	0,05	-0,01	0,04	0,03	0,04	0,06	0,34	**1,00**	0,69
JB1	0,16	0,11	0,14	0,13	0,11	0,06	0,11	0,14	0,15	0,15	0,37	0,69	**1,00**

Table 56: Portfolio Correlations - 5.11.2010-3.03.2011 (Bloomberg L.P., 2017, own graph)

TSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,27	0,19	0,16	0,16	0,09	-0,08	-0,12	-0,08	-0,04	0,00	0,05	0,13	0,14
TU1	0,27	**1,00**	0,90	0,83	0,77	0,01	0,33	0,40	0,41	0,37	0,08	0,15	0,08	0,10
FV1	0,19	0,90	**1,00**	0,97	0,90	-0,06	0,34	0,43	0,43	0,35	0,04	0,07	0,00	0,04
TY1	0,16	0,83	0,97	**1,00**	0,95	-0,09	0,32	0,42	0,43	0,35	0,01	0,04	-0,03	0,03
US1	0,16	0,77	0,90	0,95	**1,00**	-0,05	0,29	0,38	0,40	0,34	0,05	0,05	-0,03	0,03
ER1	0,09	0,01	-0,06	-0,09	-0,05	**1,00**	0,62	0,36	0,15	0,03	-0,09	-0,19	-0,21	-0,17
DU1	-0,08	0,33	0,34	0,32	0,29	0,62	**1,00**	0,88	0,69	0,56	0,02	0,11	-0,06	-0,01
OE1	-0,12	0,40	0,43	0,42	0,38	0,36	0,88	**1,00**	0,92	0,80	0,08	0,26	0,08	0,12
RX1	-0,08	0,41	0,43	0,43	0,40	0,15	0,69	0,92	**1,00**	0,94	0,05	0,28	0,08	0,09
UB1	-0,04	0,37	0,35	0,35	0,34	0,03	0,56	0,80	0,94	**1,00**	0,06	0,28	0,13	0,11
XM1	0,00	0,08	0,04	0,01	0,05	-0,09	0,02	0,08	0,05	0,06	**1,00**	0,33	0,00	0,00
YE1	0,05	0,15	0,07	0,04	0,05	-0,19	0,11	0,26	0,28	0,28	0,60	**1,00**	0,63	0,64
IR1	0,13	0,08	0,00	-0,03	-0,03	-0,21	-0,06	0,08	0,08	0,13	0,33	0,63	**1,00**	0,79
JB1	0,14	0,10	0,04	0,03	0,03	-0,17	-0,01	0,12	0,09	0,11	0,33	0,64	0,79	**1,00**

1. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,27	0,19	0,15	0,14	0,10	-0,04	-0,10	-0,06	-0,04	0,00	0,10	0,11	0,08
TU1	0,27	**1,00**	0,91	0,83	0,76	-0,01	0,17	0,37	0,38	0,35	0,07	0,13	0,07	0,01
FV1	0,19	0,91	**1,00**	0,95	0,89	-0,07	0,18	0,39	0,41	0,35	0,05	0,06	0,01	-0,01
TY1	0,15	0,83	0,95	**1,00**	0,95	-0,09	0,19	0,40	0,44	0,36	0,03	0,04	-0,01	-0,02
US1	0,14	0,76	0,89	0,95	**1,00**	-0,05	0,15	0,33	0,39	0,35	0,06	0,04	-0,02	-0,20
ER1	0,10	-0,01	-0,07	-0,09	-0,05	**1,00**	0,09	0,19	0,16	0,03	-0,09	-0,17	-0,20	-0,01
DU1	-0,04	0,17	0,18	0,19	0,15	0,09	**1,00**	0,77	0,18	0,16	0,10	0,15	-0,01	0,08
OE1	-0,10	0,37	0,39	0,40	0,33	0,19	0,77	**1,00**	0,68	0,60	0,12	0,28	0,08	0,11
RX1	-0,06	0,38	0,41	0,44	0,39	0,16	0,18	0,68	**1,00**	0,93	0,06	0,27	0,11	0,15
UB1	-0,04	0,35	0,35	0,36	0,35	0,03	0,16	0,60	0,93	**1,00**	0,06	0,28	0,15	0,00
XM1	0,00	0,07	0,05	0,03	0,06	-0,09	0,10	0,12	0,06	0,06	**1,00**	0,35	0,00	0,12
YE1	0,10	0,13	0,06	0,04	0,04	-0,17	0,15	0,28	0,27	0,28	0,54	**1,00**	0,56	1,00
IR1	0,11	0,07	0,01	-0,01	-0,02	-0,20	-0,01	0,08	0,11	0,15	0,32	0,56	**1,00**	0,12
JB1	0,08	0,12	0,07	0,08	0,08	-0,17	0,14	0,19	0,11	0,11	0,35	0,57	0,12	**1,00**

2. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,00	0,22	-0,02	0,00	0,09	0,12	0,00	0,00	0,00	-0,01	0,00	0,00	0,00
TU1	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FV1	0,22	0,00	**1,00**	0,00	0,00	-0,08	-0,23	0,00	0,00	0,00	0,02	0,00	0,00	0,00
TY1	-0,02	0,00	0,00	**1,00**	0,00	-0,01	-0,12	0,00	0,00	0,00	0,04	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ER1	0,09	0,00	-0,08	-0,01	0,00	**1,00**	-0,24	0,00	0,00	0,00	-0,09	0,00	0,00	0,00
DU1	0,12	0,00	-0,23	-0,12	0,00	-0,24	**1,00**	0,00	0,00	0,00	-0,14	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
XM1	-0,01	0,00	0,02	0,04	0,00	-0,09	-0,14	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
YE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	1,00
IR1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,32	-0,20	-0,21	-0,19	0,27	-0,32	-0,16	0,02	0,00	0,00	-0,07	0,14	-0,05
TU1	0,32	**1,00**	-0,85	-0,85	-0,78	0,19	0,08	0,06	-0,44	-0,40	-0,08	-0,16	0,09	-0,02
FV1	-0,20	-0,85	**1,00**	0,89	0,81	-0,13	-0,11	-0,06	0,45	0,40	0,02	0,08	-0,02	0,01
TY1	-0,21	-0,85	0,89	**1,00**	0,95	-0,06	-0,12	-0,09	0,45	0,41	0,02	0,04	0,01	0,02
US1	-0,19	-0,78	0,81	0,95	**1,00**	-0,05	-0,11	-0,06	0,40	0,39	0,05	0,05	0,02	-0,10
ER1	0,27	0,19	-0,13	-0,06	-0,05	**1,00**	-0,26	-0,40	-0,26	-0,15	0,05	0,06	-0,10	-0,04
DU1	-0,32	0,08	-0,11	-0,12	-0,11	-0,26	**1,00**	0,49	-0,23	-0,21	0,00	-0,09	-0,04	0,18
OE1	-0,16	0,06	-0,06	-0,09	-0,06	-0,40	0,49	**1,00**	-0,06	-0,11	-0,09	-0,18	0,18	-0,09
RX1	0,02	-0,44	0,45	0,45	0,40	-0,26	-0,23	-0,06	**1,00**	0,96	0,05	0,28	-0,09	-0,13
UB1	0,00	-0,40	0,40	0,41	0,39	-0,15	-0,21	-0,11	0,96	**1,00**	0,06	0,30	-0,13	0,00
XM1	0,00	-0,08	0,02	0,02	0,05	0,05	0,00	-0,09	0,05	0,06	**1,00**	0,26	0,00	-0,68
YE1	-0,07	-0,16	0,08	0,04	0,05	0,06	-0,09	-0,18	0,28	0,30	0,60	**1,00**	-0,63	1,00
IR1	0,14	0,09	-0,02	0,01	0,02	-0,10	-0,04	0,18	-0,09	-0,13	-0,33	-0,63	**1,00**	-0,68
JB1	-0,05	-0,19	0,11	0,12	0,09	0,09	-0,03	-0,16	0,16	0,17	0,26	0,57	-0,68	**1,00**

CSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,31	0,00	-0,15	-0,18	0,28	-0,20	0,00	0,00	-0,16	0,00	0,02	0,12	0,00
TU1	0,31	**1,00**	0,00	-0,74	-0,75	0,21	0,24	0,00	0,00	-0,26	-0,13	0,09	-0,10	0,00
FV1	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,20
TY1	-0,15	-0,74	0,00	**1,00**	0,90	0,03	-0,25	0,00	0,00	-0,01	-0,04	-0,14	0,20	0,16
US1	-0,18	-0,75	0,00	0,90	**1,00**	-0,06	-0,21	0,00	0,00	0,13	0,05	-0,07	0,16	-0,07
ER1	0,28	0,21	0,00	0,03	-0,06	**1,00**	0,12	0,00	0,00	-0,46	0,06	-0,19	-0,07	-0,07
DU1	-0,20	0,24	0,00	-0,25	-0,21	0,12	**1,00**	0,00	0,00	0,07	-0,10	-0,13	-0,07	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	-0,19
UB1	-0,16	-0,26	0,00	-0,01	0,13	-0,46	0,07	0,00	0,00	**1,00**	0,04	0,07	-0,19	0,00
XM1	0,00	-0,13	0,00	-0,04	0,05	0,06	-0,10	0,00	0,00	0,04	**1,00**	0,00	0,00	0,00
YE1	0,02	0,09	0,00	-0,14	-0,07	-0,19	-0,13	0,00	0,00	0,07	-0,07	**1,00**	-0,04	1,00
IR1	0,12	-0,10	0,00	0,20	0,16	-0,07	-0,07	0,00	0,00	-0,19	-0,41	-0,04	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,42	0,38	0,28	0,28	0,08	-0,03	0,14	0,19	0,21	-0,08	0,03	0,07	-0,04
TU1	0,42	**1,00**	0,83	0,32	0,27	0,11	0,34	0,22	0,12	-0,05	-0,10	0,18	0,01	0,09
FV1	0,38	0,83	**1,00**	0,50	0,45	0,10	0,26	0,20	0,15	0,02	-0,11	0,11	-0,01	0,08
TY1	0,28	0,32	0,50	**1,00**	0,85	0,18	-0,02	0,26	0,03	-0,11	0,00	0,13	-0,08	0,11
US1	0,28	0,27	0,45	0,85	**1,00**	0,18	-0,10	0,15	0,02	-0,09	-0,03	0,04	0,05	0,12
ER1	0,08	0,11	0,10	0,18	0,18	**1,00**	0,12	0,28	-0,05	-0,03	0,10	0,06	-0,08	-0,04
DU1	-0,03	0,34	0,26	-0,02	-0,10	0,12	**1,00**	0,52	-0,10	-0,05	-0,04	0,23	-0,18	0,00
OE1	0,14	0,22	0,20	0,26	0,15	0,28	0,52	**1,00**	0,08	0,05	-0,05	0,45	-0,22	0,09
RX1	0,19	0,12	0,15	0,03	0,02	-0,05	-0,10	0,08	**1,00**	0,70	-0,17	0,02	-0,17	0,10
UB1	0,21	-0,05	0,02	-0,11	-0,09	-0,03	-0,05	0,05	0,70	**1,00**	-0,22	-0,04	-0,08	-0,09
XM1	-0,08	-0,10	-0,11	0,00	-0,03	0,10	-0,04	-0,05	-0,17	-0,22	**1,00**	-0,30	0,11	0,02
YE1	0,03	0,18	0,11	0,13	0,04	0,06	0,23	0,45	0,02	-0,04	-0,30	**1,00**	-0,13	0,37
IR1	0,07	0,01	-0,01	-0,08	0,05	-0,08	-0,18	-0,22	-0,17	-0,08	0,11	-0,13	**1,00**	-0,12
JB1	-0,04	0,09	0,08	0,11	0,12	-0,04	0,00	0,09	0,10	-0,09	0,02	0,37	-0,12	**1,00**

CSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	-0,01	0,01	0,05	0,06	-0,03	0,09	0,02	-0,16	-0,08	-0,09	0,17	-0,02	-0,07
TU1	-0,01	**1,00**	0,65	0,33	0,10	-0,28	0,15	0,14	-0,01	-0,19	0,02	-0,08	0,01	-0,04
FV1	0,01	0,65	**1,00**	0,55	0,15	-0,27	0,13	0,06	-0,16	-0,19	-0,07	-0,03	0,16	0,05
TY1	0,05	0,33	0,55	**1,00**	0,62	-0,21	-0,09	-0,08	-0,25	-0,10	0,09	-0,08	0,23	0,12
US1	0,06	0,10	0,15	0,62	**1,00**	-0,10	-0,17	-0,07	-0,32	0,05	0,09	0,01	0,26	-0,03
ER1	-0,03	-0,28	-0,27	-0,21	-0,10	**1,00**	-0,09	-0,06	0,02	-0,05	0,01	0,10	-0,03	0,05
DU1	0,09	0,15	0,13	-0,09	-0,17	-0,09	**1,00**	0,50	0,02	-0,15	0,03	-0,04	-0,05	-0,04
OE1	0,02	0,14	0,06	-0,08	-0,07	-0,06	0,50	**1,00**	0,27	-0,02	-0,03	0,10	-0,20	0,03
RX1	-0,16	-0,01	-0,16	-0,25	-0,32	0,02	0,02	0,27	**1,00**	0,14	0,06	-0,11	-0,12	-0,04
UB1	-0,08	-0,19	-0,19	-0,10	0,05	-0,05	-0,15	-0,02	0,14	**1,00**	-0,02	0,06	-0,06	0,19
XM1	-0,09	0,02	-0,07	0,09	0,09	0,01	0,03	-0,03	0,06	-0,02	**1,00**	-0,18	0,06	-0,01
YE1	0,17	-0,08	-0,03	-0,08	0,01	0,10	-0,04	0,10	-0,11	0,06	-0,18	**1,00**	-0,07	0,06
IR1	-0,02	0,01	0,16	0,23	0,26	-0,03	-0,05	-0,20	-0,12	-0,06	0,06	-0,07	**1,00**	-0,16
JB1	-0,07	-0,04	0,05	0,12	-0,03	0,05	-0,04	0,03	-0,04	0,19	-0,01	0,06	-0,16	**1,00**

B&H	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,27	0,19	0,16	0,16	0,09	-0,08	-0,12	-0,08	-0,04	0,00	0,05	0,13	0,14
TU1	0,27	**1,00**	0,90	0,83	0,77	0,01	0,34	0,40	0,41	0,37	0,08	0,15	0,08	0,10
FV1	0,19	0,90	**1,00**	0,97	0,90	-0,06	0,34	0,43	0,43	0,35	0,04	0,07	0,00	0,04
TY1	0,16	0,83	0,97	**1,00**	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
US1	0,16	0,77	0,90	0,95	**1,00**	-0,05	0,28	0,38	0,40	0,34	0,05	0,05	-0,03	0,03
ER1	0,09	0,01	-0,06	-0,09	-0,05	**1,00**	0,63	0,36	0,15	0,03	-0,09	-0,19	-0,21	-0,17
DU1	-0,08	0,34	0,34	0,31	0,28	0,63	**1,00**	0,87	0,66	0,52	0,04	0,11	-0,04	0,00
OE1	-0,12	0,40	0,43	0,42	0,38	0,36	0,87	**1,00**	0,92	0,80	0,08	0,26	0,08	0,12
RX1	-0,08	0,41	0,43	0,43	0,40	0,15	0,66	0,92	**1,00**	0,94	0,05	0,28	0,08	0,09
UB1	-0,04	0,37	0,35	0,35	0,34	0,03	0,52	0,80	0,94	**1,00**	0,06	0,28	0,13	0,11
XM1	0,00	0,08	0,04	0,01	0,05	-0,09	0,04	0,08	0,05	0,06	**1,00**	0,60	0,33	0,33
YE1	0,05	0,15	0,07	0,04	0,05	-0,19	0,11	0,26	0,28	0,28	0,60	**1,00**	0,63	0,64
IR1	0,13	0,08	0,00	-0,03	-0,03	-0,21	-0,04	0,08	0,08	0,13	0,33	0,63	**1,00**	0,79
JB1	0,14	0,10	0,04	0,03	0,03	-0,17	0,00	0,12	0,09	0,11	0,33	0,64	0,79	**1,00**

Table 57: Portfolio Correlations - Inverted In-Sample (Bloomberg L.P., 2017, own graph)

TSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,23	0,18	0,09	-0,01	0,24	0,06	0,00	-0,06	-0,10	-0,04	-0,04	0,04	-0,03
TU1	0,23	**1,00**	0,78	0,67	0,53	0,15	0,31	0,37	0,32	0,26	0,02	0,11	0,05	0,05
FV1	0,18	0,78	**1,00**	0,96	0,84	0,16	0,15	0,44	0,55	0,48	0,04	0,10	0,02	0,05
TY1	0,09	0,67	0,96	**1,00**	0,94	0,15	0,08	0,43	0,61	0,55	0,05	0,10	0,00	0,07
US1	-0,01	0,53	0,84	0,94	**1,00**	0,13	0,00	0,39	0,61	0,58	0,06	0,07	-0,01	0,07
ER1	0,24	0,15	0,16	0,15	0,13	**1,00**	0,06	0,26	0,29	0,22	0,08	0,04	0,02	0,02
DU1	0,06	0,31	0,15	0,08	0,00	0,06	**1,00**	0,33	-0,02	-0,06	0,01	0,06	-0,04	-0,01
OE1	0,00	0,37	0,44	0,43	0,39	0,26	0,33	**1,00**	0,62	0,53	0,07	0,16	0,01	0,11
RX1	-0,06	0,32	0,55	0,61	0,61	0,29	-0,02	0,62	**1,00**	0,93	0,10	0,15	0,06	0,14
UB1	-0,10	0,26	0,48	0,55	0,58	0,22	-0,06	0,53	0,93	**1,00**	0,11	0,13	0,05	0,12
XM1	-0,04	0,02	0,04	0,05	0,06	0,08	0,01	0,07	0,10	0,11	**1,00**	0,19	0,14	0,21
YE1	-0,04	0,11	0,10	0,10	0,07	0,04	0,06	0,16	0,15	0,13	0,19	**1,00**	0,16	0,26
IR1	0,04	0,05	0,02	0,00	-0,01	0,02	-0,04	0,01	0,06	0,05	0,14	0,16	**1,00**	0,39
JB1	-0,03	0,05	0,05	0,07	0,07	0,02	-0,01	0,11	0,14	0,12	0,21	0,26	0,39	**1,00**

1. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,26	0,20	0,10	-0,01	0,00	-0,01	-0,02	-0,01	0,03	-0,04	0,01	-0,02	-0,03
TU1	0,26	**1,00**	0,87	0,72	0,56	-0,02	-0,02	-0,02	-0,02	-0,01	0,03	0,00	-0,02	0,03
FV1	0,20	0,87	**1,00**	0,94	0,79	-0,02	-0,02	-0,03	-0,02	-0,01	0,04	-0,01	-0,01	0,05
TY1	0,10	0,72	0,94	**1,00**	0,93	-0,02	-0,02	-0,03	-0,02	-0,01	0,05	-0,04	-0,01	0,07
US1	-0,01	0,56	0,79	0,93	**1,00**	-0,02	-0,01	-0,02	-0,03	-0,01	0,07	-0,07	0,00	0,06
ER1	0,00	-0,02	-0,02	-0,02	-0,02	**1,00**	0,58	0,63	0,11	-0,18	0,00	0,01	0,60	-0,01
DU1	-0,01	-0,02	-0,02	-0,02	-0,01	0,58	**1,00**	0,95	-0,09	-0,22	0,00	-0,01	0,21	0,01
OE1	-0,02	-0,02	-0,03	-0,03	-0,02	0,63	0,95	**1,00**	-0,13	-0,28	-0,01	0,01	0,26	0,00
RX1	-0,01	-0,02	-0,02	-0,02	-0,03	0,11	-0,09	-0,13	**1,00**	0,59	0,01	-0,09	0,14	0,01
UB1	0,03	-0,01	-0,01	-0,01	-0,01	-0,18	-0,22	-0,28	0,59	**1,00**	-0,01	-0,03	-0,12	-0,03
XM1	-0,04	0,03	0,04	0,05	0,07	0,00	0,00	-0,01	0,01	-0,01	**1,00**	-0,44	0,03	0,18
YE1	0,01	0,00	-0,01	-0,04	-0,07	0,01	-0,01	0,01	-0,09	-0,03	-0,44	**1,00**	0,01	-0,10
IR1	-0,02	-0,02	-0,01	-0,01	0,00	0,60	0,21	0,26	0,14	-0,12	0,03	0,01	**1,00**	0,00
JB1	-0,03	0,03	0,05	0,07	0,06	-0,01	0,01	0,00	0,01	-0,03	0,18	-0,10	0,00	**1,00**

2. CSC	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,08	0,27	0,01	0,00	-0,03	-0,03	-0,02	0,00	0,00	0,00	-0,01	-0,02	0,00
TU1	0,08	**1,00**	0,33	0,00	0,00	0,02	0,01	-0,01	0,00	0,00	0,00	0,00	-0,02	0,00
FV1	0,27	0,33	**1,00**	0,00	0,00	-0,02	0,00	-0,02	0,00	0,00	0,00	-0,01	-0,01	0,00
TY1	0,01	0,00	0,00	**1,00**	0,00	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00
US1	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ER1	-0,03	0,02	-0,02	0,01	0,00	**1,00**	0,33	-0,25	0,00	0,00	0,00	-0,01	0,39	0,00
DU1	-0,03	0,01	0,00	0,01	0,00	0,33	**1,00**	0,27	0,00	0,00	0,00	-0,03	0,00	0,00
OE1	-0,02	-0,01	-0,02	0,01	0,00	-0,25	0,27	**1,00**	0,00	0,00	0,00	-0,06	0,13	0,00
RX1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00
XM1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
YE1	-0,01	0,00	-0,01	0,00	0,00	-0,01	-0,03	-0,06	0,00	0,00	0,00	**1,00**	0,01	0,00
IR1	-0,02	-0,02	-0,01	0,00	0,00	0,39	0,00	0,13	0,00	0,00	0,00	0,01	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,09	-0,19	-0,07	0,02	0,00	-0,01	0,09	0,09	0,12	0,04	0,06	-0,02	0,03
TU1	0,09	**1,00**	-0,24	-0,47	-0,43	-0,06	-0,14	-0,22	-0,25	-0,23	-0,05	-0,04	-0,03	-0,02
FV1	-0,19	-0,24	**1,00**	0,47	0,32	0,03	0,05	0,11	0,09	0,06	0,04	0,07	0,00	0,03
TY1	-0,07	-0,47	0,47	**1,00**	0,89	0,10	0,26	0,42	0,54	0,48	0,04	0,12	0,00	0,06
US1	0,02	-0,43	0,32	0,89	**1,00**	0,10	0,25	0,43	0,59	0,55	0,06	0,14	-0,01	0,07
ER1	0,00	-0,06	0,03	0,10	0,10	**1,00**	0,45	0,37	0,25	0,22	0,11	0,11	0,00	0,06
DU1	-0,01	-0,14	0,05	0,26	0,25	0,45	**1,00**	0,64	0,41	0,35	0,05	0,08	-0,01	0,07
OE1	0,09	-0,22	0,11	0,42	0,43	0,37	0,64	**1,00**	0,73	0,65	0,06	0,19	-0,02	0,11
RX1	0,09	-0,25	0,09	0,54	0,59	0,25	0,41	0,73	**1,00**	0,93	0,10	0,23	-0,01	0,14
UB1	0,12	-0,23	0,06	0,48	0,55	0,22	0,35	0,65	0,93	**1,00**	0,11	0,22	0,00	0,12
XM1	0,04	-0,05	0,04	0,04	0,06	0,11	0,05	0,06	0,10	0,11	**1,00**	0,62	-0,01	0,17
YE1	0,06	-0,04	0,07	0,12	0,14	0,11	0,08	0,19	0,23	0,22	0,62	**1,00**	0,04	0,35
IR1	-0,02	-0,03	0,00	0,00	-0,01	0,00	-0,01	-0,02	-0,01	0,00	-0,01	0,04	**1,00**	0,18
JB1	0,03	-0,02	0,03	0,06	0,07	0,06	0,07	0,11	0,14	0,12	0,17	0,35	0,18	**1,00**

CSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,76	-0,54	-0,03	-0,02	0,01	0,32	0,00	0,06	0,16	0,12	0,77	0,04	0,00
TU1	0,76	**1,00**	-0,82	-0,04	-0,39	0,04	0,51	0,01	-0,11	-0,19	0,14	0,65	0,02	0,00
FV1	-0,54	-0,82	**1,00**	0,00	0,67	0,00	-0,78	0,00	0,19	0,48	-0,31	-0,53	0,00	0,00
TY1	-0,03	-0,04	0,00	**1,00**	0,12	-0,11	-0,03	-0,12	0,00	0,02	0,00	0,02	0,01	0,00
US1	-0,02	-0,39	0,67	0,12	**1,00**	-0,03	-0,83	-0,03	0,00	0,68	-0,32	-0,03	0,01	0,00
ER1	0,01	0,04	0,00	-0,11	-0,03	**1,00**	0,05	0,28	0,00	-0,01	0,00	0,00	-0,02	0,01
DU1	0,32	0,51	-0,78	-0,03	-0,83	0,05	**1,00**	0,03	0,00	-0,62	0,48	0,29	0,01	0,00
OE1	0,00	0,01	0,00	-0,12	-0,03	0,28	0,03	**1,00**	0,01	0,00	-0,01	0,00	-0,01	-0,03
RX1	0,06	-0,11	0,19	0,00	0,00	0,00	0,00	0,01	**1,00**	0,63	-0,33	-0,36	-0,02	0,00
UB1	0,16	-0,19	0,48	0,02	0,68	-0,01	-0,62	0,00	0,63	**1,00**	-0,50	-0,14	0,00	0,00
XM1	0,12	0,14	-0,31	0,00	-0,32	0,00	0,48	-0,01	-0,33	-0,50	**1,00**	0,44	0,04	0,01
YE1	0,77	0,65	-0,53	0,02	-0,03	0,00	0,29	0,00	-0,36	-0,14	0,44	**1,00**	0,04	0,00
IR1	0,04	0,02	0,00	0,01	0,01	-0,02	0,01	-0,01	-0,02	0,00	0,04	0,04	**1,00**	-0,05
JB1	0,00	0,00	0,00	0,00	0,00	0,01	0,00	-0,03	0,00	0,00	0,01	0,00	-0,05	**1,00**

TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,09	0,09	0,09	0,06	0,10	0,03	0,04	-0,07	-0,07	0,00	-0,02	-0,03	-0,01
TU1	0,09	**1,00**	0,59	0,46	0,31	0,04	0,15	0,19	-0,01	-0,03	0,02	0,01	0,01	-0,01
FV1	0,09	0,59	**1,00**	0,76	0,53	0,01	0,19	0,25	0,03	0,01	0,05	0,00	-0,01	-0,04
TY1	0,09	0,46	0,76	**1,00**	0,74	0,02	0,16	0,28	-0,01	-0,01	0,05	-0,01	-0,03	-0,01
US1	0,06	0,31	0,53	0,74	**1,00**	0,00	0,09	0,24	-0,01	-0,03	0,01	0,01	-0,02	0,00
ER1	0,10	0,04	0,01	0,02	0,00	**1,00**	0,01	0,04	0,03	0,04	-0,04	0,05	0,03	-0,03
DU1	0,03	0,15	0,19	0,16	0,09	0,01	**1,00**	0,56	0,01	0,00	0,03	-0,03	-0,01	-0,01
OE1	0,04	0,19	0,25	0,28	0,24	0,04	0,56	**1,00**	-0,01	-0,01	0,03	0,03	-0,05	-0,03
RX1	-0,07	-0,01	0,03	-0,01	-0,01	0,03	0,01	-0,01	**1,00**	0,75	-0,03	0,01	-0,02	0,01
UB1	-0,07	-0,03	0,01	-0,01	-0,03	0,04	0,00	-0,01	0,75	**1,00**	-0,02	0,00	0,01	-0,01
XM1	0,00	0,02	0,05	0,05	0,01	-0,04	0,03	0,03	-0,03	-0,02	**1,00**	0,06	-0,04	0,00
YE1	-0,02	0,01	0,00	-0,01	0,01	0,05	-0,03	0,03	0,01	0,00	0,06	**1,00**	0,06	0,13
IR1	-0,03	0,01	-0,01	-0,03	-0,02	0,03	-0,01	-0,05	-0,02	0,01	-0,04	0,06	**1,00**	-0,01
JB1	-0,01	-0,01	-0,04	-0,01	0,00	-0,03	-0,01	-0,03	0,01	-0,01	0,00	0,13	-0,01	**1,00**

CSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	-0,04	-0,01	-0,03	0,08	0,01	0,03	0,12	0,04	0,08	0,04	0,04	-0,01	0,01
TU1	-0,04	**1,00**	0,53	0,30	0,08	0,01	0,00	-0,07	-0,09	-0,01	-0,02	0,01	-0,01	0,00
FV1	-0,01	0,53	**1,00**	0,49	0,22	-0,06	0,02	-0,05	-0,07	0,02	-0,01	-0,01	-0,02	-0,01
TY1	-0,03	0,30	0,49	**1,00**	0,58	-0,08	-0,04	-0,02	-0,03	0,01	-0,01	-0,03	-0,02	0,04
US1	0,08	0,08	0,22	0,58	**1,00**	-0,08	-0,03	-0,02	-0,03	0,01	0,00	-0,02	0,01	0,00
ER1	0,01	0,01	-0,06	-0,08	-0,08	**1,00**	-0,03	-0,06	-0,07	0,04	-0,02	-0,03	0,02	-0,06
DU1	0,03	0,00	0,02	-0,04	-0,03	-0,03	**1,00**	0,46	0,24	-0,03	-0,02	-0,03	-0,04	0,02
OE1	0,12	-0,07	-0,05	-0,02	-0,02	-0,06	0,46	**1,00**	0,57	-0,01	0,02	-0,01	-0,02	0,00
RX1	0,04	-0,09	-0,07	-0,03	-0,03	-0,07	0,24	0,57	**1,00**	-0,01	-0,01	0,04	-0,01	-0,06
UB1	0,08	-0,01	0,02	0,01	0,01	0,04	-0,03	-0,01	-0,01	**1,00**	0,01	-0,01	-0,03	0,05
XM1	0,04	-0,02	-0,01	-0,01	0,00	-0,02	-0,02	0,02	-0,01	0,01	**1,00**	0,07	-0,01	0,02
YE1	0,04	0,01	-0,01	-0,03	-0,02	-0,03	-0,03	-0,01	0,04	-0,01	0,07	**1,00**	0,05	0,14
IR1	-0,01	-0,01	-0,02	-0,02	0,01	0,02	-0,04	-0,02	-0,01	-0,03	-0,01	0,05	**1,00**	0,06
JB1	0,01	0,00	-0,01	0,04	0,00	-0,06	0,02	0,00	-0,06	0,05	0,02	0,14	0,06	**1,00**

B&H	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,25	0,18	0,09	-0,01	0,24	-0,04	-0,05	-0,06	-0,10	-0,04	-0,05	0,04	-0,03
TU1	0,25	**1,00**	0,86	0,76	0,61	0,16	0,41	0,43	0,40	0,33	0,04	0,11	0,06	0,04
FV1	0,18	0,86	**1,00**	0,96	0,84	0,16	0,46	0,55	0,55	0,48	0,04	0,11	0,02	0,05
TY1	0,09	0,76	0,96	**1,00**	0,94	0,15	0,47	0,59	0,61	0,55	0,05	0,13	0,01	0,07
US1	-0,01	0,61	0,84	0,94	**1,00**	0,14	0,45	0,57	0,61	0,58	0,06	0,14	-0,01	0,07
ER1	0,24	0,16	0,16	0,15	0,14	**1,00**	0,55	0,40	0,29	0,22	0,08	0,07	0,02	0,02
DU1	-0,04	0,41	0,46	0,47	0,45	0,55	**1,00**	0,88	0,74	0,62	0,09	0,16	0,02	0,08
OE1	-0,05	0,43	0,55	0,59	0,57	0,40	0,88	**1,00**	0,94	0,83	0,08	0,20	0,04	0,12
RX1	-0,06	0,40	0,55	0,61	0,61	0,29	0,74	0,94	**1,00**	0,93	0,10	0,23	0,06	0,14
UB1	-0,10	0,33	0,48	0,55	0,58	0,22	0,62	0,83	0,93	**1,00**	0,11	0,22	0,06	0,12
XM1	-0,04	0,04	0,04	0,05	0,06	0,08	0,09	0,08	0,10	0,11	**1,00**	0,62	0,13	0,21
YE1	-0,05	0,11	0,11	0,13	0,14	0,07	0,16	0,20	0,23	0,22	0,62	**1,00**	0,22	0,41
IR1	0,04	0,06	0,02	0,01	-0,01	0,02	0,02	0,04	0,06	0,06	0,13	0,22	**1,00**	0,41
JB1	-0,03	0,04	0,05	0,07	0,07	0,02	0,08	0,12	0,14	0,12	0,21	0,41	0,41	**1,00**

Table 58: Portfolio Correlations - Inverted Out-of-Sample (Bloomberg L.P., 2017, own graph)

TSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,57	0,63	0,59	0,56	0,39	0,20	0,40	0,43	0,36	0,09	0,06	0,06
TU1	0,57	**1,00**	0,87	0,77	0,65	0,19	0,32	0,50	0,47	0,38	0,09	0,02	0,03
FV1	0,63	0,87	**1,00**	0,89	0,79	0,24	0,30	0,55	0,54	0,45	0,12	0,03	0,03
TY1	0,59	0,77	0,89	**1,00**	0,90	0,23	0,26	0,52	0,55	0,47	0,10	0,03	0,04
US1	0,56	0,65	0,79	0,90	**1,00**	0,21	0,21	0,48	0,53	0,48	0,09	0,04	0,07
ER1	0,39	0,19	0,24	0,23	0,21	**1,00**	0,22	0,45	0,48	0,39	0,17	0,08	0,10
DU1	0,20	0,32	0,30	0,26	0,21	0,22	**1,00**	0,58	0,44	0,34	0,09	0,05	0,06
OE1	0,40	0,50	0,55	0,52	0,48	0,45	0,58	**1,00**	0,86	0,71	0,18	0,05	0,07
RX1	0,43	0,47	0,54	0,55	0,53	0,48	0,44	0,86	**1,00**	0,88	0,17	0,04	0,07
UB1	0,36	0,38	0,45	0,47	0,48	0,39	0,34	0,71	0,88	**1,00**	0,13	0,03	0,05
XM1	0,09	0,09	0,12	0,10	0,09	0,17	0,09	0,18	0,17	0,13	**1,00**	0,10	0,16
YE1	0,06	0,02	0,03	0,03	0,04	0,08	0,05	0,05	0,04	0,03	0,10	**1,00**	0,43
JB1	0,06	0,03	0,03	0,04	0,07	0,10	0,06	0,07	0,07	0,05	0,16	0,43	**1,00**

1. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,00	0,31	0,28	0,16	0,41	-0,20	-0,07	0,35	0,30	0,08	0,08	0,08
TU1	0,00	**1,00**	0,72	0,61	0,48	-0,06	-0,05	0,03	0,14	0,08	-0,04	-0,02	-0,05
FV1	0,31	0,72	**1,00**	0,90	0,67	0,12	-0,19	-0,04	0,34	0,26	0,04	-0,02	-0,03
TY1	0,28	0,61	0,90	**1,00**	0,83	0,13	-0,18	-0,05	0,29	0,19	0,06	0,01	-0,02
US1	0,16	0,48	0,67	0,83	**1,00**	0,06	-0,13	-0,04	0,10	0,02	0,02	0,01	0,00
ER1	0,41	-0,06	0,12	0,13	0,06	**1,00**	-0,27	-0,12	0,38	0,33	0,15	0,08	0,08
DU1	-0,20	-0,05	-0,19	-0,18	-0,13	-0,27	**1,00**	0,66	-0,29	-0,28	-0,08	-0,01	-0,02
OE1	-0,07	0,03	-0,04	-0,05	-0,04	-0,12	0,66	**1,00**	-0,01	-0,08	-0,04	0,01	-0,03
RX1	0,35	0,14	0,34	0,29	0,10	0,38	-0,29	-0,01	**1,00**	0,85	0,18	-0,01	0,03
UB1	0,30	0,08	0,26	0,19	0,02	0,33	-0,28	-0,08	0,85	**1,00**	0,15	-0,03	0,03
XM1	0,08	-0,04	0,04	0,06	0,02	0,15	-0,08	-0,04	0,18	0,15	**1,00**	-0,01	0,11
YE1	0,08	-0,02	-0,02	0,01	0,01	0,08	-0,01	0,01	-0,01	-0,03	-0,01	**1,00**	0,23
JB1	0,08	-0,05	-0,03	-0,02	0,00	0,08	-0,02	-0,03	0,03	0,03	0,11	0,23	**1,00**

2. CSC	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,30	-0,16	-0,17	-0,11	0,39	-0,21	-0,05	0,03	0,00	0,04	0,05	0,00
TU1	-0,30	**1,00**	0,80	0,03	0,00	-0,15	0,03	0,01	0,00	0,00	-0,09	-0,05	0,00
FV1	-0,16	0,80	**1,00**	0,01	-0,01	-0,07	-0,04	-0,01	0,00	0,00	-0,08	-0,03	0,00
TY1	-0,17	0,03	0,01	**1,00**	0,86	-0,10	0,02	0,01	0,00	0,00	-0,01	-0,05	0,00
US1	-0,11	0,00	-0,01	0,86	**1,00**	-0,05	0,00	0,00	0,00	0,00	-0,01	-0,04	0,00
ER1	0,39	-0,15	-0,07	-0,10	-0,05	**1,00**	-0,35	-0,06	0,00	0,00	0,13	0,05	0,00
DU1	-0,21	0,03	-0,04	0,02	0,00	-0,35	**1,00**	0,25	0,05	0,00	-0,10	0,01	0,00
OE1	-0,05	0,01	-0,01	0,01	0,00	-0,06	0,25	**1,00**	0,22	0,00	0,00	0,00	0,00
RX1	0,03	0,00	0,00	0,00	0,00	0,00	0,05	0,22	**1,00**	0,00	0,00	0,00	0,00
UB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00
XM1	0,04	-0,09	-0,08	-0,01	-0,01	0,13	-0,10	0,00	0,00	0,00	**1,00**	0,00	0,00
YE1	0,05	-0,05	-0,03	-0,05	-0,04	0,05	0,01	0,00	0,00	0,00	0,00	**1,00**	0,00
JB1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**

TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,67	0,61	0,56	0,48	0,35	0,45	0,42	0,37	0,29	0,11	0,01	0,08
TU1	0,67	**1,00**	0,95	0,89	0,78	0,38	0,59	0,59	0,56	0,44	0,13	0,00	0,08
FV1	0,61	0,95	**1,00**	0,97	0,89	0,36	0,59	0,62	0,61	0,50	0,14	0,00	0,06
TY1	0,56	0,89	0,97	**1,00**	0,95	0,35	0,60	0,64	0,64	0,55	0,12	-0,01	0,06
US1	0,48	0,78	0,89	0,95	**1,00**	0,30	0,55	0,60	0,63	0,56	0,09	0,00	0,05
ER1	0,35	0,38	0,36	0,35	0,30	**1,00**	0,72	0,63	0,53	0,39	0,17	-0,02	0,09
DU1	0,45	0,59	0,59	0,60	0,55	0,72	**1,00**	0,95	0,85	0,69	0,16	-0,06	0,08
OE1	0,42	0,59	0,62	0,64	0,60	0,63	0,95	**1,00**	0,94	0,79	0,17	-0,05	0,06
RX1	0,37	0,56	0,61	0,64	0,63	0,53	0,85	0,94	**1,00**	0,90	0,18	-0,04	0,05
UB1	0,29	0,44	0,50	0,55	0,56	0,39	0,69	0,79	0,90	**1,00**	0,13	-0,05	0,04
XM1	0,11	0,13	0,14	0,12	0,09	0,17	0,16	0,17	0,18	0,13	**1,00**	-0,07	0,13
YE1	0,01	0,00	0,00	-0,01	0,00	-0,02	-0,06	-0,05	-0,04	-0,05	-0,07	**1,00**	-0,05
JB1	0,08	0,08	0,06	0,06	0,05	0,09	0,08	0,06	0,05	0,04	0,13	-0,05	**1,00**

CSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,17	0,00	0,00	-0,01	0,00	0,00	0,00	-0,04	-0,05	0,04	0,00	0,00
TU1	0,17	**1,00**	0,67	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,00	0,00
FV1	0,00	0,67	**1,00**	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,03	-0,01	0,00
TY1	0,00	0,00	0,01	**1,00**	0,49	0,00	0,00	0,00	0,00	0,00	0,05	-0,02	0,00
US1	-0,01	0,00	0,01	0,49	**1,00**	0,00	0,00	0,00	0,00	0,41	0,10	-0,04	0,01
ER1	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,01	0,02	0,00	-0,01	0,00
DU1	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00
OE1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**	0,00	0,00	0,00	0,00	0,00
RX1	-0,04	0,00	0,00	0,00	0,00	0,01	0,00	0,00	**1,00**	0,37	0,06	-0,03	0,00
UB1	-0,05	0,00	0,00	0,00	0,41	0,02	0,00	0,00	0,37	**1,00**	0,16	-0,05	-0,02
XM1	0,04	0,04	0,03	0,05	0,10	0,00	0,00	0,00	0,06	0,16	**1,00**	-0,10	-0,02
YE1	0,00	0,00	-0,01	-0,02	-0,04	-0,01	0,00	0,00	-0,03	-0,05	-0,10	**1,00**	0,12
JB1	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	-0,02	-0,02	0,12	**1,00**

TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,07	0,07	0,04	0,02	0,12	0,08	0,04	0,02	0,05	-0,02	0,02	0,04
TU1	0,07	**1,00**	0,77	0,65	0,44	0,04	0,22	0,20	-0,01	-0,02	-0,02	-0,02	-0,01
FV1	0,07	0,77	**1,00**	0,85	0,62	0,06	0,21	0,22	0,01	0,01	0,00	-0,02	-0,01
TY1	0,04	0,65	0,85	**1,00**	0,73	0,07	0,22	0,24	0,00	0,01	0,01	-0,02	-0,02
US1	0,02	0,44	0,62	0,73	**1,00**	0,05	0,19	0,20	0,01	0,01	-0,02	0,00	-0,02
ER1	0,12	0,04	0,06	0,07	0,05	**1,00**	0,15	0,08	-0,03	0,00	0,02	0,01	-0,02
DU1	0,08	0,22	0,21	0,22	0,19	0,15	**1,00**	0,72	0,01	0,02	0,00	-0,01	0,02
OE1	0,04	0,20	0,22	0,24	0,20	0,08	0,72	**1,00**	-0,01	-0,01	0,03	-0,02	0,02
RX1	0,02	-0,01	0,01	0,00	0,01	-0,03	0,01	-0,01	**1,00**	0,75	-0,02	0,01	-0,01
UB1	0,05	-0,02	0,01	0,01	0,01	0,00	0,02	-0,01	0,75	**1,00**	-0,04	0,01	-0,01
XM1	-0,02	-0,02	0,00	0,01	-0,02	0,02	0,00	0,03	-0,02	-0,04	**1,00**	0,01	0,01
YE1	0,02	-0,02	-0,02	-0,02	0,00	0,01	-0,01	-0,02	0,01	0,01	0,01	**1,00**	0,09
JB1	0,04	-0,01	-0,01	-0,02	-0,02	-0,02	0,02	0,02	-0,01	-0,01	0,01	0,09	**1,00**

CSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	-0,10	-0,10	-0,16	-0,10	0,11	-0,07	-0,13	-0,11	0,01	0,02	-0,02	0,03
TU1	-0,10	**1,00**	0,48	0,28	0,03	-0,02	-0,07	-0,09	-0,11	0,01	-0,03	-0,03	-0,02
FV1	-0,10	0,48	**1,00**	0,56	0,23	0,02	-0,10	-0,14	-0,16	0,01	-0,08	-0,01	-0,02
TY1	-0,16	0,28	0,56	**1,00**	0,48	-0,05	-0,15	-0,16	-0,09	0,00	0,00	0,01	-0,05
US1	-0,10	0,03	0,23	0,48	**1,00**	-0,01	-0,13	-0,13	-0,08	-0,02	-0,01	0,02	-0,05
ER1	0,11	-0,02	0,02	-0,05	-0,01	**1,00**	-0,08	-0,09	-0,11	-0,03	-0,01	0,04	-0,03
DU1	-0,07	-0,07	-0,10	-0,15	-0,13	-0,08	**1,00**	0,47	0,23	-0,05	0,00	0,00	0,03
OE1	-0,13	-0,09	-0,14	-0,16	-0,13	-0,09	0,47	**1,00**	0,46	-0,03	-0,03	-0,01	0,01
RX1	-0,11	-0,11	-0,16	-0,09	-0,08	-0,11	0,23	0,46	**1,00**	-0,05	-0,03	-0,01	-0,01
UB1	0,01	0,01	0,01	0,00	-0,02	-0,03	-0,05	-0,03	-0,05	**1,00**	0,03	-0,01	0,00
XM1	0,02	-0,03	-0,08	0,00	-0,01	-0,01	0,00	-0,03	-0,03	0,03	**1,00**	0,02	0,00
YE1	-0,02	-0,03	-0,01	0,01	0,02	0,04	0,00	-0,01	-0,01	-0,01	0,02	**1,00**	0,06
JB1	0,03	-0,02	-0,02	-0,05	-0,05	-0,03	0,03	0,01	-0,01	0,00	0,00	0,06	**1,00**

B&H	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,84	0,79	0,74	0,64	0,39	0,55	0,53	0,47	0,36	0,09	0,06	0,06
TU1	0,84	**1,00**	0,95	0,89	0,78	0,38	0,59	0,59	0,56	0,44	0,13	0,05	0,07
FV1	0,79	0,95	**1,00**	0,97	0,89	0,36	0,59	0,62	0,61	0,50	0,14	0,04	0,07
TY1	0,74	0,89	0,97	**1,00**	0,95	0,35	0,60	0,64	0,64	0,55	0,12	0,03	0,07
US1	0,64	0,78	0,89	0,95	**1,00**	0,30	0,55	0,60	0,63	0,56	0,09	0,04	0,07
ER1	0,39	0,38	0,36	0,35	0,30	**1,00**	0,72	0,63	0,53	0,39	0,17	0,07	0,10
DU1	0,55	0,59	0,59	0,60	0,55	0,72	**1,00**	0,95	0,85	0,69	0,16	0,06	0,09
OE1	0,53	0,59	0,62	0,64	0,60	0,63	0,95	**1,00**	0,94	0,79	0,17	0,06	0,09
RX1	0,47	0,56	0,61	0,64	0,63	0,53	0,85	0,94	**1,00**	0,90	0,18	0,04	0,07
UB1	0,36	0,44	0,50	0,55	0,56	0,39	0,69	0,79	0,90	**1,00**	0,13	0,03	0,05
XM1	0,09	0,13	0,14	0,12	0,09	0,17	0,16	0,17	0,18	0,13	**1,00**	0,10	0,16
YE1	0,06	0,05	0,04	0,03	0,04	0,07	0,06	0,06	0,04	0,03	0,10	**1,00**	0,43
JB1	0,06	0,07	0,07	0,07	0,07	0,10	0,09	0,09	0,07	0,05	0,16	0,43	**1,00**

Table 59: Combined Portfolio Correlations - In-Sample (Bloomberg L.P., 2017, own graph)

TSC & TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,21	0,27	0,26	0,24	0,33	0,05	0,21	0,24	0,16	0,05	0,02	-0,08
TU1	0,21	**1,00**	0,81	0,70	0,54	0,16	0,25	0,38	0,32	0,22	0,06	-0,01	-0,05
FV1	0,27	0,81	**1,00**	0,87	0,69	0,15	0,24	0,41	0,39	0,28	0,04	0,00	-0,02
TY1	0,26	0,70	0,87	**1,00**	0,83	0,18	0,24	0,41	0,43	0,32	0,05	0,00	-0,02
US1	0,24	0,54	0,69	0,83	**1,00**	0,16	0,18	0,38	0,42	0,35	0,07	0,00	0,01
ER1	0,33	0,16	0,15	0,18	0,16	**1,00**	0,11	0,26	0,27	0,23	0,11	0,03	-0,02
DU1	0,05	0,25	0,24	0,24	0,18	0,11	**1,00**	0,63	0,51	0,35	0,02	0,03	0,02
OE1	0,21	0,38	0,41	0,41	0,38	0,26	0,63	**1,00**	0,84	0,62	0,15	0,05	0,02
RX1	0,24	0,32	0,39	0,43	0,42	0,27	0,51	0,84	**1,00**	0,75	0,15	0,07	0,01
UB1	0,16	0,22	0,28	0,32	0,35	0,23	0,35	0,62	0,75	**1,00**	0,12	0,07	0,01
XM1	0,05	0,06	0,04	0,05	0,07	0,11	0,02	0,15	0,15	0,12	**1,00**	0,10	0,00
YE1	0,02	-0,01	0,00	0,00	0,00	0,03	0,03	0,05	0,07	0,07	0,10	**1,00**	0,02
JB1	-0,08	-0,05	-0,02	-0,02	0,01	-0,02	0,02	0,02	0,01	0,01	0,00	0,02	**1,00**

TSC & TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,62	0,55	0,52	0,47	0,39	0,32	0,38	0,39	0,31	0,09	0,06	-0,12
TU1	0,62	**1,00**	0,87	0,80	0,69	0,32	0,46	0,52	0,49	0,37	0,13	0,01	-0,06
FV1	0,55	0,87	**1,00**	0,96	0,87	0,31	0,49	0,59	0,58	0,45	0,14	0,02	-0,03
TY1	0,52	0,80	0,96	**1,00**	0,94	0,32	0,49	0,60	0,61	0,49	0,12	0,01	-0,02
US1	0,47	0,69	0,87	0,94	**1,00**	0,29	0,44	0,57	0,60	0,52	0,10	0,02	-0,01
ER1	0,39	0,32	0,31	0,32	0,29	**1,00**	0,49	0,54	0,50	0,40	0,16	0,07	-0,07
DU1	0,32	0,46	0,49	0,49	0,44	0,49	**1,00**	0,82	0,74	0,60	0,14	0,09	-0,01
OE1	0,38	0,52	0,59	0,60	0,57	0,54	0,82	**1,00**	0,93	0,78	0,19	0,09	-0,01
RX1	0,39	0,49	0,58	0,61	0,60	0,50	0,74	0,93	**1,00**	0,88	0,21	0,09	0,01
UB1	0,31	0,37	0,45	0,49	0,52	0,40	0,60	0,78	0,88	**1,00**	0,17	0,08	0,00
XM1	0,09	0,13	0,14	0,12	0,10	0,16	0,14	0,19	0,21	0,17	**1,00**	0,14	0,00
YE1	0,06	0,01	0,02	0,01	0,02	0,07	0,09	0,09	0,09	0,08	0,14	**1,00**	0,04
JB1	-0,12	-0,06	-0,03	-0,02	-0,01	-0,07	-0,01	-0,01	0,01	0,00	0,00	0,04	**1,00**

TSV & TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,28	0,21	0,20	0,15	0,25	0,17	0,15	0,11	0,07	0,02	-0,01	-0,08
TU1	0,28	**1,00**	0,76	0,67	0,54	0,22	0,36	0,39	0,36	0,32	0,05	-0,02	-0,05
FV1	0,21	0,76	**1,00**	0,89	0,75	0,23	0,42	0,47	0,47	0,39	0,04	-0,03	-0,01
TY1	0,20	0,67	0,89	**1,00**	0,86	0,24	0,44	0,49	0,51	0,43	0,06	-0,02	-0,03
US1	0,15	0,54	0,75	0,86	**1,00**	0,20	0,40	0,47	0,49	0,43	0,07	-0,02	0,01
ER1	0,25	0,22	0,23	0,24	0,20	**1,00**	0,46	0,40	0,31	0,23	0,11	0,00	-0,02
DU1	0,17	0,36	0,42	0,44	0,40	0,46	**1,00**	0,83	0,72	0,55	0,13	0,02	0,00
OE1	0,15	0,39	0,47	0,49	0,47	0,40	0,83	**1,00**	0,86	0,68	0,16	0,02	0,02
RX1	0,11	0,36	0,47	0,51	0,49	0,31	0,72	0,86	**1,00**	0,79	0,16	0,03	0,00
UB1	0,07	0,32	0,39	0,43	0,43	0,23	0,55	0,68	0,79	**1,00**	0,12	0,04	0,00
XM1	0,02	0,05	0,04	0,06	0,07	0,11	0,13	0,16	0,16	0,12	**1,00**	0,00	0,00
YE1	-0,01	-0,02	-0,03	-0,02	-0,02	0,00	0,02	0,02	0,03	0,04	0,00	**1,00**	0,03
JB1	-0,08	-0,05	-0,01	-0,03	0,01	-0,02	0,00	0,02	0,00	0,00	0,00	0,03	**1,00**

All Three	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,24	0,24	0,23	0,20	0,32	0,13	0,16	0,16	0,12	0,03	0,01	-0,09
TU1	0,24	**1,00**	0,75	0,64	0,51	0,18	0,30	0,37	0,32	0,26	0,06	0,00	-0,05
FV1	0,24	0,75	**1,00**	0,88	0,72	0,20	0,34	0,45	0,43	0,34	0,06	0,01	-0,02
TY1	0,23	0,64	0,88	**1,00**	0,85	0,21	0,35	0,46	0,47	0,38	0,07	0,01	-0,02
US1	0,20	0,51	0,72	0,85	**1,00**	0,19	0,31	0,42	0,45	0,40	0,08	0,00	0,01
ER1	0,32	0,18	0,20	0,21	0,19	**1,00**	0,28	0,32	0,29	0,24	0,11	0,03	-0,02
DU1	0,13	0,30	0,34	0,35	0,31	0,28	**1,00**	0,74	0,63	0,50	0,09	0,06	0,01
OE1	0,16	0,37	0,45	0,46	0,42	0,32	0,74	**1,00**	0,85	0,66	0,15	0,06	0,01
RX1	0,16	0,32	0,43	0,47	0,45	0,29	0,63	0,85	**1,00**	0,78	0,16	0,07	0,01
UB1	0,12	0,26	0,34	0,38	0,40	0,24	0,50	0,66	0,78	**1,00**	0,12	0,08	0,01
XM1	0,03	0,06	0,06	0,07	0,08	0,11	0,09	0,15	0,16	0,12	**1,00**	0,07	0,00
YE1	0,01	0,00	0,01	0,01	0,00	0,03	0,06	0,06	0,07	0,08	0,07	**1,00**	0,05
JB1	-0,09	-0,05	-0,02	-0,02	0,01	-0,02	0,01	0,01	0,01	0,01	0,00	0,05	**1,00**

Table 60: Combined Portfolio Correlations - Out-of-Sample (Bloomberg L.P., 2017, own graph)

TSC & TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,31	0,24	0,24	0,19	0,09	-0,05	0,00	0,07	0,08	0,03	0,03	-0,01	0,01
TU1	0,31	**1,00**	0,78	0,63	0,46	-0,01	0,14	0,19	0,23	0,26	0,02	0,09	-0,01	0,06
FV1	0,24	0,78	**1,00**	0,85	0,66	0,02	0,12	0,29	0,37	0,37	0,03	0,09	0,01	0,07
TY1	0,24	0,63	0,85	**1,00**	0,83	0,02	0,06	0,31	0,45	0,43	0,04	0,07	-0,02	0,05
US1	0,19	0,46	0,66	0,83	**1,00**	0,04	0,01	0,29	0,48	0,47	0,07	0,07	-0,01	0,06
ER1	0,09	-0,01	0,02	0,02	0,04	**1,00**	-0,05	0,14	0,12	0,08	-0,07	0,06	0,03	0,04
DU1	-0,05	0,14	0,12	0,06	0,01	-0,05	**1,00**	0,40	0,11	0,07	0,01	0,02	-0,03	0,00
OE1	0,00	0,19	0,29	0,31	0,29	0,14	0,40	**1,00**	0,61	0,45	0,01	0,09	0,02	0,06
RX1	0,07	0,23	0,37	0,45	0,48	0,12	0,11	0,61	**1,00**	0,83	0,06	0,09	0,01	0,10
UB1	0,08	0,26	0,37	0,43	0,47	0,08	0,07	0,45	0,83	**1,00**	0,09	0,11	0,01	0,12
XM1	0,03	0,02	0,03	0,04	0,07	-0,07	0,01	0,01	0,06	0,09	**1,00**	0,11	0,00	0,00
YE1	0,03	0,09	0,09	0,07	0,07	0,06	0,02	0,09	0,09	0,11	0,19	**1,00**	0,02	0,19
IR1	-0,01	-0,01	0,01	-0,02	-0,01	0,03	-0,03	0,02	0,01	0,01	0,07	0,02	**1,00**	0,05
JB1	0,01	0,06	0,07	0,05	0,06	0,04	0,00	0,06	0,10	0,12	0,11	0,19	0,05	**1,00**

TSC & TSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,58	0,26	0,20	0,16	-0,06	-0,11	-0,11	0,02	0,07	0,02	0,07	-0,04	0,01
TU1	0,58	**1,00**	0,47	0,33	0,29	-0,04	-0,01	0,02	0,04	0,14	0,01	0,07	-0,03	0,01
FV1	0,26	0,47	**1,00**	0,86	0,73	0,02	-0,03	0,17	0,35	0,40	0,05	0,13	-0,01	0,05
TY1	0,20	0,33	0,86	**1,00**	0,93	0,04	-0,17	0,18	0,52	0,55	0,06	0,12	0,00	0,07
US1	0,16	0,29	0,73	0,93	**1,00**	0,03	-0,21	0,13	0,49	0,57	0,06	0,11	0,01	0,05
ER1	-0,06	-0,04	0,02	0,04	0,03	**1,00**	0,07	0,27	0,18	0,10	0,05	0,07	0,05	0,01
DU1	-0,11	-0,01	-0,03	-0,17	-0,21	0,07	**1,00**	0,33	-0,25	-0,28	-0,01	-0,02	-0,01	0,01
OE1	-0,11	0,02	0,17	0,18	0,13	0,27	0,33	**1,00**	0,49	0,25	0,04	0,09	0,05	0,07
RX1	0,02	0,04	0,35	0,52	0,49	0,18	-0,25	0,49	**1,00**	0,78	0,08	0,17	0,02	0,10
UB1	0,07	0,14	0,40	0,55	0,57	0,10	-0,28	0,25	0,78	**1,00**	0,11	0,20	-0,01	0,08
XM1	0,02	0,01	0,05	0,06	0,06	0,05	-0,01	0,04	0,08	0,11	**1,00**	0,17	0,00	0,00
YE1	0,07	0,07	0,13	0,12	0,11	0,07	-0,02	0,09	0,17	0,20	0,45	**1,00**	-0,02	0,27
IR1	-0,04	-0,03	-0,01	0,00	0,01	0,05	-0,01	0,05	0,02	-0,01	0,04	-0,02	**1,00**	0,11
JB1	0,01	0,01	0,05	0,07	0,05	0,01	0,01	0,07	0,10	0,08	0,17	0,27	0,11	**1,00**

TSV & TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,24	0,02	0,10	0,13	0,07	-0,09	0,06	0,09	0,07	0,07	0,08	-0,01	0,04
TU1	0,24	**1,00**	0,27	0,11	0,03	0,03	0,07	0,04	-0,04	-0,04	-0,01	0,01	-0,02	-0,03
FV1	0,02	0,27	**1,00**	0,64	0,45	-0,04	0,10	0,13	0,07	0,20	0,02	0,05	0,01	0,01
TY1	0,10	0,11	0,64	**1,00**	0,83	-0,03	0,00	0,13	0,24	0,34	0,04	0,08	0,02	0,02
US1	0,13	0,03	0,45	0,83	**1,00**	-0,02	-0,03	0,09	0,24	0,37	0,07	0,11	0,03	0,01
ER1	0,07	0,03	-0,04	-0,03	-0,02	**1,00**	0,06	0,11	0,02	0,03	0,02	0,03	-0,03	0,01
DU1	-0,09	0,07	0,10	0,00	-0,03	0,06	**1,00**	0,52	0,14	0,07	0,05	-0,06	0,00	-0,04
OE1	0,06	0,04	0,13	0,13	0,09	0,11	0,52	**1,00**	0,56	0,33	0,03	-0,01	0,00	0,01
RX1	0,09	-0,04	0,07	0,24	0,24	0,02	0,14	0,56	**1,00**	0,63	0,01	0,02	0,02	0,05
UB1	0,07	-0,04	0,20	0,34	0,37	0,03	0,07	0,33	0,63	**1,00**	0,07	0,09	0,00	0,03
XM1	0,07	-0,01	0,02	0,04	0,07	0,02	0,05	0,03	0,01	0,07	**1,00**	0,05	0,00	0,00
YE1	0,08	0,01	0,05	0,08	0,11	0,03	-0,06	-0,01	0,02	0,09	0,40	**1,00**	-0,05	0,11
IR1	-0,01	-0,02	0,01	0,02	0,03	-0,03	0,00	0,00	0,02	0,00	0,00	-0,05	**1,00**	-0,02
JB1	0,04	-0,03	0,01	0,02	0,01	0,01	-0,04	0,01	0,05	0,03	0,05	0,11	-0,02	**1,00**

All Three	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,39	0,13	0,18	0,16	-0,01	-0,09	-0,08	0,01	0,03	0,05	0,02	-0,07	-0,01
TU1	0,39	**1,00**	0,41	0,33	0,24	-0,03	0,04	0,07	0,07	0,09	0,00	0,04	-0,07	0,01
FV1	0,13	0,41	**1,00**	0,74	0,55	-0,01	0,04	0,18	0,23	0,30	0,03	0,09	-0,03	0,04
TY1	0,18	0,33	0,74	**1,00**	0,83	0,00	-0,02	0,20	0,37	0,41	0,04	0,07	-0,02	0,03
US1	0,16	0,24	0,55	0,83	**1,00**	-0,01	-0,06	0,17	0,38	0,45	0,07	0,07	0,00	0,03
ER1	-0,01	-0,03	-0,01	0,00	-0,01	**1,00**	-0,03	0,03	0,03	0,02	0,00	0,03	0,03	0,03
DU1	-0,09	0,04	0,04	-0,02	-0,06	-0,03	**1,00**	0,40	0,04	0,01	0,01	-0,03	-0,01	-0,04
OE1	-0,08	0,07	0,18	0,20	0,17	0,03	0,40	**1,00**	0,48	0,32	0,03	0,05	0,01	0,03
RX1	0,01	0,07	0,23	0,37	0,38	0,03	0,04	0,48	**1,00**	0,72	0,05	0,07	0,01	0,06
UB1	0,03	0,09	0,30	0,41	0,45	0,02	0,01	0,32	0,72	**1,00**	0,09	0,09	-0,02	0,06
XM1	0,05	0,00	0,03	0,04	0,07	0,00	0,01	0,03	0,05	0,09	**1,00**	0,10	0,00	0,00
YE1	0,02	0,04	0,09	0,07	0,07	0,03	-0,03	0,05	0,07	0,09	0,25	**1,00**	0,01	0,17
IR1	-0,07	-0,07	-0,03	-0,02	0,00	0,03	-0,01	0,01	0,01	-0,02	0,02	0,01	**1,00**	0,06
JB1	-0,01	0,01	0,04	0,03	0,03	0,03	-0,04	0,03	0,06	0,06	0,10	0,17	0,06	**1,00**

Table 61: Combined Portfolio Correlations - Inverted In-Sample (Bloomberg L.P., 2017, own graph)

TSC & TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,07	0,06	0,01	-0,05	0,21	0,05	0,00	-0,12	-0,07	0,00	-0,06	-0,01	-0,04
TU1	0,07	**1,00**	0,68	0,55	0,41	0,08	0,21	0,29	0,24	0,18	0,01	0,04	0,04	0,01
FV1	0,06	0,68	**1,00**	0,86	0,67	0,09	0,17	0,39	0,41	0,33	0,05	0,05	0,00	0,03
TY1	0,01	0,55	0,86	**1,00**	0,83	0,10	0,14	0,39	0,47	0,40	0,06	0,03	-0,04	0,03
US1	-0,05	0,41	0,67	0,83	**1,00**	0,06	0,05	0,33	0,44	0,40	0,03	0,03	-0,04	0,04
ER1	0,21	0,08	0,09	0,10	0,06	**1,00**	0,05	0,16	0,16	0,15	0,00	0,01	-0,01	-0,01
DU1	0,05	0,21	0,17	0,14	0,05	0,05	**1,00**	0,44	0,16	0,09	0,00	0,03	-0,02	-0,01
OE1	0,00	0,29	0,39	0,39	0,33	0,16	0,44	**1,00**	0,67	0,56	0,05	0,12	-0,01	0,05
RX1	-0,12	0,24	0,41	0,47	0,44	0,16	0,16	0,67	**1,00**	0,83	0,04	0,12	0,04	0,07
UB1	-0,07	0,18	0,33	0,40	0,40	0,15	0,09	0,56	0,83	**1,00**	0,05	0,08	0,02	0,05
XM1	0,00	0,01	0,05	0,06	0,03	0,00	0,00	0,05	0,04	0,05	**1,00**	0,08	0,06	0,11
YE1	-0,06	0,04	0,05	0,03	0,03	0,01	0,03	0,12	0,12	0,08	0,08	**1,00**	0,15	0,18
IR1	-0,01	0,04	0,00	-0,04	-0,04	-0,01	-0,02	-0,01	0,04	0,02	0,06	0,15	**1,00**	0,24
JB1	-0,04	0,01	0,03	0,03	0,04	-0,01	-0,01	0,05	0,07	0,05	0,11	0,18	0,24	**1,00**

TSC & TSV	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,20	0,15	0,10	0,06	0,04	-0,05	0,06	0,05	0,04	0,00	0,03	0,00	-0,01
TU1	0,20	**1,00**	0,36	0,19	0,10	0,06	0,19	0,14	0,05	0,02	-0,03	0,07	-0,01	0,03
FV1	0,15	0,36	**1,00**	0,81	0,67	0,12	0,29	0,39	0,37	0,31	0,04	0,12	0,01	0,05
TY1	0,10	0,19	0,81	**1,00**	0,92	0,15	0,23	0,49	0,59	0,52	0,05	0,14	0,00	0,07
US1	0,06	0,10	0,67	0,92	**1,00**	0,13	0,16	0,46	0,60	0,57	0,06	0,12	-0,01	0,07
ER1	0,04	0,06	0,12	0,15	0,13	**1,00**	0,34	0,36	0,31	0,25	0,11	0,09	0,02	0,05
DU1	-0,05	0,19	0,29	0,23	0,16	0,34	**1,00**	0,54	0,25	0,19	0,05	0,07	-0,01	0,04
OE1	0,06	0,14	0,39	0,49	0,46	0,36	0,54	**1,00**	0,75	0,66	0,07	0,20	0,02	0,13
RX1	0,05	0,05	0,37	0,59	0,60	0,31	0,25	0,75	**1,00**	0,93	0,10	0,22	0,03	0,15
UB1	0,04	0,02	0,31	0,52	0,57	0,25	0,19	0,66	0,93	**1,00**	0,11	0,20	0,03	0,12
XM1	0,00	-0,03	0,04	0,05	0,06	0,11	0,05	0,07	0,10	0,11	**1,00**	0,46	0,07	0,19
YE1	0,03	0,07	0,12	0,14	0,12	0,09	0,07	0,20	0,22	0,20	0,46	**1,00**	0,14	0,37
IR1	0,00	-0,01	0,01	0,00	-0,01	0,02	-0,01	0,02	0,03	0,03	0,07	0,14	**1,00**	0,32
JB1	-0,01	0,03	0,05	0,07	0,07	0,05	0,04	0,13	0,15	0,12	0,19	0,37	0,32	**1,00**

TSV & TSM	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,15	-0,11	-0,07	-0,02	-0,03	-0,03	0,01	-0,02	-0,03	0,00	0,03	-0,02	0,01
TU1	0,15	**1,00**	0,12	-0,05	-0,07	0,00	-0,06	-0,07	-0,10	-0,11	-0,02	-0,06	-0,02	0,01
FV1	-0,11	0,12	**1,00**	0,60	0,42	0,03	0,14	0,18	0,16	0,09	0,06	0,06	-0,01	0,02
TY1	-0,07	-0,05	0,60	**1,00**	0,80	0,07	0,26	0,39	0,43	0,36	0,06	0,07	-0,04	0,03
US1	-0,02	-0,07	0,42	0,80	**1,00**	0,05	0,21	0,35	0,43	0,39	0,03	0,10	-0,04	0,04
ER1	-0,03	0,00	0,03	0,07	0,05	**1,00**	0,27	0,23	0,17	0,14	0,03	0,06	0,01	0,01
DU1	-0,03	-0,06	0,14	0,26	0,21	0,27	**1,00**	0,63	0,43	0,34	0,03	0,03	0,00	0,03
OE1	0,01	-0,07	0,18	0,39	0,35	0,23	0,63	**1,00**	0,75	0,62	0,05	0,13	-0,03	0,05
RX1	-0,02	-0,10	0,16	0,43	0,43	0,17	0,43	0,75	**1,00**	0,83	0,04	0,18	-0,01	0,07
UB1	-0,03	-0,11	0,09	0,36	0,39	0,14	0,34	0,62	0,83	**1,00**	0,05	0,14	-0,02	0,04
XM1	0,00	-0,02	0,06	0,06	0,03	0,03	0,03	0,05	0,04	0,05	**1,00**	0,30	-0,04	0,09
YE1	0,03	-0,06	0,06	0,07	0,10	0,06	0,03	0,13	0,18	0,14	0,30	**1,00**	0,08	0,24
IR1	-0,02	-0,02	-0,01	-0,04	-0,04	0,01	0,00	-0,03	-0,01	-0,02	-0,04	0,08	**1,00**	0,16
JB1	0,01	0,01	0,02	0,03	0,04	0,01	0,03	0,05	0,07	0,04	0,09	0,24	0,16	**1,00**

All Three	US					EU					AUS		JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	IR1	XM1	YE1	JB1
ED1	**1,00**	0,13	0,06	0,04	0,02	0,01	-0,05	0,03	0,03	0,02	0,00	0,01	-0,01	-0,02
TU1	0,13	**1,00**	0,29	0,17	0,09	0,01	0,08	0,05	0,01	-0,01	-0,01	-0,01	0,01	-0,01
FV1	0,06	0,29	**1,00**	0,72	0,53	0,09	0,24	0,34	0,29	0,21	0,02	0,08	-0,01	0,01
TY1	0,04	0,17	0,72	**1,00**	0,82	0,12	0,21	0,40	0,45	0,39	0,06	0,08	-0,04	0,03
US1	0,02	0,09	0,53	0,82	**1,00**	0,08	0,14	0,33	0,44	0,40	0,03	0,09	-0,04	0,04
ER1	0,01	0,01	0,09	0,12	0,08	**1,00**	0,16	0,25	0,21	0,17	0,02	0,05	0,01	0,02
DU1	-0,05	0,08	0,24	0,21	0,14	0,16	**1,00**	0,51	0,28	0,20	0,03	0,04	0,00	0,02
OE1	0,03	0,05	0,34	0,40	0,33	0,25	0,51	**1,00**	0,69	0,57	0,05	0,14	-0,03	0,06
RX1	0,03	0,01	0,29	0,45	0,44	0,21	0,28	0,69	**1,00**	0,83	0,04	0,16	0,00	0,08
UB1	0,02	-0,01	0,21	0,39	0,40	0,17	0,20	0,57	0,83	**1,00**	0,05	0,11	-0,01	0,04
XM1	0,00	-0,01	0,02	0,06	0,03	0,02	0,03	0,05	0,04	0,05	**1,00**	0,18	0,03	0,09
YE1	0,01	-0,01	0,08	0,08	0,09	0,05	0,04	0,14	0,16	0,11	0,18	**1,00**	0,11	0,24
IR1	-0,01	0,01	-0,01	-0,04	-0,04	0,01	0,00	-0,03	0,00	-0,01	0,03	0,11	**1,00**	0,21
JB1	-0,02	-0,01	0,01	0,03	0,04	0,02	0,02	0,06	0,08	0,04	0,09	0,24	0,21	**1,00**

Table 62: Combined Portfolio Correlations - Inverted Out-of-Sample (Bloomberg L.P., 2017, own graph)

TSC & TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,36	0,41	0,36	0,31	0,25	0,20	0,26	0,25	0,19	0,02	0,05	0,02
TU1	0,36	**1,00**	0,81	0,68	0,52	0,12	0,26	0,34	0,31	0,26	0,02	0,03	0,01
FV1	0,41	0,81	**1,00**	0,86	0,70	0,17	0,24	0,39	0,39	0,35	0,06	0,03	0,01
TY1	0,36	0,68	0,86	**1,00**	0,82	0,17	0,23	0,40	0,40	0,35	0,07	0,03	0,02
US1	0,31	0,52	0,70	0,82	**1,00**	0,14	0,17	0,36	0,40	0,36	0,05	0,04	0,04
ER1	0,25	0,12	0,17	0,17	0,14	**1,00**	0,20	0,30	0,26	0,25	0,09	0,04	0,02
DU1	0,20	0,26	0,24	0,23	0,17	0,20	**1,00**	0,64	0,49	0,35	0,02	0,03	0,04
OE1	0,26	0,34	0,39	0,40	0,36	0,30	0,64	**1,00**	0,81	0,62	0,11	0,01	0,04
RX1	0,25	0,31	0,39	0,40	0,40	0,26	0,49	0,81	**1,00**	0,77	0,11	0,02	0,02
UB1	0,19	0,26	0,35	0,35	0,36	0,25	0,35	0,62	0,77	**1,00**	0,07	0,03	-0,01
XM1	0,02	0,02	0,06	0,07	0,05	0,09	0,02	0,11	0,11	0,07	**1,00**	0,08	0,07
YE1	0,05	0,03	0,03	0,03	0,04	0,04	0,03	0,01	0,02	0,03	0,08	**1,00**	0,24
JB1	0,02	0,01	0,01	0,02	0,04	0,02	0,04	0,04	0,02	-0,01	0,07	0,24	**1,00**

TSC & TSV	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,72	0,68	0,64	0,57	0,38	0,41	0,45	0,43	0,34	0,10	0,06	0,07
TU1	0,72	**1,00**	0,93	0,87	0,76	0,31	0,52	0,57	0,54	0,45	0,12	0,02	0,06
FV1	0,68	0,93	**1,00**	0,95	0,87	0,31	0,51	0,61	0,60	0,50	0,13	0,02	0,05
TY1	0,64	0,87	0,95	**1,00**	0,94	0,31	0,51	0,62	0,63	0,54	0,12	0,01	0,05
US1	0,57	0,76	0,87	0,94	**1,00**	0,27	0,46	0,58	0,61	0,55	0,09	0,02	0,07
ER1	0,38	0,31	0,31	0,31	0,27	**1,00**	0,56	0,56	0,51	0,39	0,17	0,04	0,10
DU1	0,41	0,52	0,51	0,51	0,46	0,56	**1,00**	0,84	0,76	0,62	0,15	0,00	0,09
OE1	0,45	0,57	0,61	0,62	0,58	0,56	0,84	**1,00**	0,93	0,79	0,18	0,00	0,07
RX1	0,43	0,54	0,60	0,63	0,61	0,51	0,76	0,93	**1,00**	0,90	0,18	0,00	0,06
UB1	0,34	0,45	0,50	0,54	0,55	0,39	0,62	0,79	0,90	**1,00**	0,13	-0,02	0,05
XM1	0,10	0,12	0,13	0,12	0,09	0,17	0,15	0,18	0,18	0,13	**1,00**	0,03	0,15
YE1	0,06	0,02	0,02	0,01	0,02	0,04	0,00	0,00	0,00	-0,02	0,03	**1,00**	0,24
JB1	0,07	0,06	0,05	0,05	0,07	0,10	0,09	0,07	0,06	0,05	0,15	0,24	**1,00**

TSV & TSM	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,38	0,38	0,34	0,27	0,24	0,26	0,25	0,21	0,17	0,03	0,02	0,03
TU1	0,38	**1,00**	0,85	0,77	0,60	0,21	0,41	0,40	0,37	0,31	0,05	0,00	0,02
FV1	0,38	0,85	**1,00**	0,91	0,76	0,23	0,43	0,44	0,44	0,38	0,07	-0,01	0,02
TY1	0,34	0,77	0,91	**1,00**	0,84	0,21	0,44	0,46	0,46	0,40	0,08	-0,01	0,03
US1	0,27	0,60	0,76	0,84	**1,00**	0,18	0,39	0,43	0,45	0,41	0,06	0,01	0,03
ER1	0,24	0,21	0,23	0,21	0,18	**1,00**	0,43	0,37	0,28	0,25	0,09	-0,02	0,03
DU1	0,26	0,41	0,43	0,44	0,39	0,43	**1,00**	0,84	0,71	0,54	0,07	-0,04	0,05
OE1	0,25	0,40	0,44	0,46	0,43	0,37	0,84	**1,00**	0,84	0,65	0,10	-0,03	0,04
RX1	0,21	0,37	0,44	0,46	0,45	0,28	0,71	0,84	**1,00**	0,78	0,11	-0,01	0,02
UB1	0,17	0,31	0,38	0,40	0,41	0,25	0,54	0,65	0,78	**1,00**	0,07	0,00	-0,02
XM1	0,03	0,05	0,07	0,08	0,06	0,09	0,07	0,10	0,11	0,07	**1,00**	-0,03	0,07
YE1	0,02	0,00	-0,01	-0,01	0,01	-0,02	-0,04	-0,03	-0,01	0,00	-0,03	**1,00**	0,02
JB1	0,03	0,02	0,02	0,03	0,03	0,03	0,05	0,04	0,02	-0,02	0,07	0,02	**1,00**

All Three	US					EU					AUS	JPN	
	ED1	TU1	FV1	TY1	US1	ER1	DU1	OE1	RX1	UB1	XM1	YE1	JB1
ED1	**1,00**	0,41	0,41	0,36	0,30	0,25	0,26	0,25	0,22	0,18	0,03	0,04	0,03
TU1	0,41	**1,00**	0,83	0,73	0,57	0,16	0,36	0,39	0,37	0,32	0,05	0,01	0,03
FV1	0,41	0,83	**1,00**	0,89	0,73	0,19	0,36	0,42	0,43	0,39	0,07	0,00	0,01
TY1	0,36	0,73	0,89	**1,00**	0,83	0,19	0,36	0,44	0,45	0,41	0,07	-0,01	0,03
US1	0,30	0,57	0,73	0,83	**1,00**	0,16	0,32	0,42	0,45	0,41	0,06	0,01	0,04
ER1	0,25	0,16	0,19	0,19	0,16	**1,00**	0,34	0,34	0,27	0,25	0,09	0,01	0,04
DU1	0,26	0,36	0,36	0,36	0,32	0,34	**1,00**	0,75	0,65	0,51	0,05	0,02	0,06
OE1	0,25	0,39	0,42	0,44	0,42	0,34	0,75	**1,00**	0,84	0,66	0,11	0,01	0,05
RX1	0,22	0,37	0,43	0,45	0,45	0,27	0,65	0,84	**1,00**	0,78	0,11	0,01	0,03
UB1	0,18	0,32	0,39	0,41	0,41	0,25	0,51	0,66	0,78	**1,00**	0,07	0,00	0,00
XM1	0,03	0,05	0,07	0,07	0,06	0,09	0,05	0,11	0,11	0,07	**1,00**	0,02	0,09
YE1	0,04	0,01	0,00	-0,01	0,01	0,01	0,02	0,01	0,01	0,00	0,02	**1,00**	0,12
JB1	0,03	0,03	0,01	0,03	0,04	0,04	0,06	0,05	0,03	0,00	0,09	0,12	**1,00**

Table 63: Correlations between TSC and TSM – all periods (Bloomberg L.P., 2017, own graph)

Correlation TSC/TSM Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,001	0,028							
Increasing Interest Rates			0,172	-0,002	0,036	0,020	0,155	0,039	-0,044

Table 64: Correlations between TSC and CSM - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSC/CSM Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,005	0,042							
Increasing Interest Rates			0,041	-0,284	-0,026	-0,080	0,123	0,074	0,095

Table 65: Correlations between TSC and TSV - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSC/TSV Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,817	0,879							
Increasing Interest Rates			0,998	0,999	1,000	0,915	0,985	0,968	0,919

Table 66: Correlations between TSC and CSV - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSC/CSV Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,800	0,262							
Increasing Interest Rates			0,880	0,910	0,965	0,908	0,825	0,106	0,863

Table 67: Correlations between TSM and 1. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSM/1. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,022	0,021							
Increasing Interest Rates			0,155	0,142	0,030	0,004	0,151	0,034	-0,020

Table 68: Correlations between TSM and 2. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSM/2. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,008	-0,057							
Increasing Interest Rates			0,036	0,068	-0,041	-0,002	0,014	0,029	0,007

Table 69: Correlations between TSM and TSV - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSM/TSV Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,008	0,030							
Increasing Interest Rates			0,180	0,006	0,036	0,011	0,171	0,038	-0,039

Table 70: Correlations between TSM and CSV - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSM/CSV Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,016	0,012							
Increasing Interest Rates			0,167	-0,065	0,069	0,010	0,137	0,019	-0,059

Table 71: Correlations between TSV and 1. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSV/1. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,461	0,826							
Increasing Interest Rates			0,628	0,903	0,976	0,970	0,944	0,905	0,620

Table 72: Correlations between TSV and 2. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSV/2. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,334	-0,248							
Increasing Interest Rates			0,149	0,894	0,545	-0,300	-0,121	-0,421	-0,144

Table 73: Correlations between 1. CSC and CSV - all periods (Bloomberg L.P., 2017, own graph)

Correlation 1. CSC/CSV Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,369	0,272							
Increasing Interest Rates			0,550	0,763	0,948	0,856	0,869	0,113	0,541

Table 74: Correlations between CSV and 2. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation CSV/2. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,198	-0,041							
Increasing Interest Rates			0,112	0,736	0,489	-0,080	-0,034	-0,033	0,009

Table 75: Correlations between TSV and CSM - all periods (Bloomberg L.P., 2017, own graph)

Correlation TSV/CSM Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,005	0,066							
Increasing Interest Rates			0,047	-0,279	-0,028	-0,071	0,131	0,080	0,095

Table 76: Correlations between CSM and 1. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation CSM/1. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,020	0,042							
Increasing Interest Rates			-0,224	-0,153	-0,037	-0,085	0,123	0,063	0,042

Table 77: Correlations between CSM and 2. CSC - all periods (Bloomberg L.P., 2017, own graph)

Correlation CSM/2. CSC Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	-0,001	-0,087							
Increasing Interest Rates			-0,360	-0,323	0,030	-0,005	0,008	-0,055	-0,013

Table 78: Correlations between CSM and CSV - all periods (Bloomberg L.P., 2017, own graph)

Correlation CSM/CSV Environment	In-Sample	Out-of-Sample	16.06.2003-02.09.2003	17.03.2004-14.06.2004	28.06.2005-14.11.2005	01.06.2005-01.06.2006	05.11.2010-03.03.2011	Inverted In-Sample	Inverted Out-of-Sample
Decreasing Interest Rates	0,018	0,009							
Increasing Interest Rates			0,117	-0,189	-0,019	-0,064	0,070	-0,012	0,076

7.5.2. Probability of Fed Policy Shift

Table 79: Probability of Fed Policy Shift: Non-adjusted Implied Rates

(Bloomberg L.P., 2017 and Federal Reserve, 2016, own graph)

Fed Funds Future Implied Information								FOMC's Monetary Policy Action			
Date of observation	Implied Rate before Adj.	Probabilities 0,25 Hike	No change	No Change	0,25 Decrease	Most probable Action	Accuracy of Signal	Date of action	Rate level Before Decision	After Decision	Effective Change
01.10.1990	8,8765%	5434%	-5334%			Hike	False	29.10.1990	8,00%	7,75%	-0,25%
30.10.1990	9,0151%	893%	-793%			Hike	False	13.11.1990	7,75%	7,50%	-0,25%
14.11.1990	9,0250%	788%	-688%			Hike	False	07.12.1990	7,50%	7,25%	-0,25%
10.12.1990	8,6401%	1326%	-1226%			Hike	False	18.12.1990	7,25%	7,00%	-0,25%
19.12.1990	8,6697%	941%	-841%			Hike	False	09.01.1991	7,00%	6,75%	-0,25%
10.01.1991	8,2663%	629%	-529%			Hike	False	01.02.1991	6,75%	6,25%	-0,50%
08.02.1991	8,1591%	1029%	-929%			Hike	False	08.03.1991	6,25%	6,00%	-0,25%
								30.04.1991	6,00%	5,75%	-0,25%
08.07.1991	7,8451%	1039%	-939%			Hike	False	06.08.1991	5,75%	5,50%	-0,25%
13.08.1991	7,6298%	1503%	-1403%			Hike	False	13.09.1991	5,50%	5,25%	-0,25%
								31.10.1991	5,25%	5,00%	-0,25%
01.11.1991	7,5421%	1271%	-1171%			Hike	False	06.11.1991	5,00%	4,75%	-0,25%
07.11.1991	7,4740%	1351%	-1251%			Hike	False	06.12.1991	4,75%	4,50%	-0,25%
09.12.1991	7,3380%	3199%	-3099%			Hike	False	20.12.1991	4,50%	4,00%	-0,50%
10.03.1992	7,3662%	1924%	-1824%			Hike	False	09.04.1992	4,00%	3,75%	-0,25%
02.06.1992	7,1151%	1439%	-1339%			Hike	False	02.07.1992	3,75%	3,25%	-0,50%
04.08.1992	6,6617%	1575%	-1475%			Hike	False	04.09.1992	3,25%	3,00%	-0,25%
04.01.1994	6,1208%	1456%	-1356%			Hike	True	04.02.1994	3,00%	3,25%	0,25%
23.02.1994	6,3048%	4209%	-4109%			Hike	True	22.03.1994	3,25%	3,50%	0,25%
23.03.1994	6,2466%	2747%	-2647%			Hike	True	18.04.1994	3,50%	3,75%	0,25%
19.04.1994	6,2563%	2220%	-2120%			Hike	True	17.05.1994	3,75%	4,25%	0,50%
15.07.1994	6,0503%	1488%	-1388%			Hike	True	16.08.1994	4,25%	4,75%	0,50%
18.10.1994	5,8424%	874%	-774%			Hike	True	15.11.1994	4,75%	5,50%	0,75%
03.01.1995	5,5618%	26%	74%			No change	False	01.02.1995	5,50%	6,00%	0,50%
07.06.1995	5,3612%			-217%	317%	Decrease	True	06.07.1995	6,00%	5,75%	-0,25%
01.12.1995	5,5418%			-115%	215%	Decrease	True	19.12.1995	5,75%	5,50%	-0,25%
								31.01.1996	5,50%	5,25%	-0,25%
03.03.1997	5,0915%			-228%	328%	Decrease	False	25.03.1997	5,25%	5,50%	0,25%
01.09.1998	4,9305%			-6734%	6834%	Decrease	True	29.09.1998	5,50%	5,25%	-0,25%
01.10.1998	4,9205%			-164%	264%	Decrease	True	15.10.1998	5,25%	5,00%	-0,25%
02.11.1998	4,8051%			-80%	180%	Decrease	True	17.11.1998	5,00%	4,75%	-0,25%
								30.06.1999	4,75%	5,00%	0,25%
02.08.1999	4,3842%			-991%	1091%	Decrease	False	24.08.1999	5,00%	5,25%	0,25%
01.11.1999	4,2529%			-755%	855%	Decrease	False	16.11.1999	5,25%	5,50%	0,25%
03.01.2000	4,1973%			-461%	561%	Decrease	False	02.02.2000	5,50%	5,75%	0,25%
01.03.2000	4,1006%			-1945%	2045%	Decrease	False	21.03.2000	5,75%	6,00%	0,25%
01.05.2000	4,1210%			-1453%	1553%	Decrease	False	16.05.2000	6,00%	6,50%	0,50%
01.12.2000	4,1721%			-931%	1031%	Decrease	True	03.01.2001	6,50%	6,00%	-0,50%
								31.01.2001	6,00%	5,50%	-0,50%
01.03.2001	3,7930%			-1824%	1924%	Decrease	True	20.03.2001	5,50%	5,00%	-0,50%
02.04.2001	3,8437%			-1056%	1156%	Decrease	True	18.04.2001	5,00%	4,50%	-0,50%
01.05.2001	3,6971%			-522%	622%	Decrease	True	15.05.2001	4,50%	4,00%	-0,50%
01.06.2001	3,5864%			-1554%	1654%	Decrease	True	27.06.2001	4,00%	3,75%	-0,25%
01.08.2001	3,6014%			-84%	184%	Decrease	True	21.08.2001	3,75%	3,50%	-0,25%
04.09.2001	3,6264%	117%	-17%			Hike	False	17.09.2001	3,50%	3,00%	-0,50%
18.09.2001	3,1320%	56%	44%			Hike	False	02.10.2001	3,00%	2,50%	-0,50%
05.10.2001	3,0925%	296%	-196%			Hike	False	06.11.2001	2,50%	2,00%	-0,50%
12.11.2001	2,9786%	639%	-539%			Hike	False	11.12.2001	2,00%	1,75%	-0,25%
07.10.2002	2,9875%	619%	-519%			Hike	False	06.11.2002	1,75%	1,25%	-0,50%
02.06.2003	2,9773%	4146%	-4046%			Hike	False	25.06.2003	1,25%	1,00%	-0,25%
								30.06.2004	1,00%	1,25%	0,25%
12.07.2004	2,9871%	1026%	-926%			Hike	True	10.08.2004	1,25%	1,50%	0,25%
01.09.2004	2,9822%	1976%	-1876%			Hike	True	21.09.2004	1,50%	1,75%	0,25%
11.10.2004	3,0315%	769%	-669%			Hike	True	10.11.2004	1,75%	2,00%	0,25%
15.11.2004	3,0562%	770%	-670%			Hike	True	14.12.2004	2,00%	2,25%	0,25%
03.01.2005	3,0779%	357%	-257%			Hike	True	02.02.2005	2,25%	2,50%	0,25%
01.03.2005	3,1077%	837%	-737%			Hike	True	22.03.2005	2,50%	2,75%	0,25%
04.04.2005	3,1375%	172%	-72%			Hike	True	03.05.2005	2,75%	3,00%	0,25%
								30.06.2005	3,00%	3,25%	0,25%
11.07.2005	3,1425%			39%	61%	Decrease	False	09.08.2005	3,25%	3,50%	0,25%
01.09.2005	3,1425%			-329%	429%	Decrease	False	20.09.2005	3,50%	3,75%	0,25%
03.10.2005	3,2027%			-126%	226%	Decrease	False	01.11.2005	3,75%	4,00%	0,25%
14.11.2005	3,1977%			-453%	553%	Decrease	False	13.12.2005	4,00%	4,25%	0,25%
								31.01.2006	4,25%	4,50%	0,25%
01.03.2006	3,2028%			-5262%	5362%	Decrease	False	28.03.2006	4,50%	4,75%	0,25%
10.04.2006	3,2485%			-787%	887%	Decrease	False	10.05.2006	4,75%	5,00%	0,25%
01.06.2006	3,2535%			-20858%	20958%	Decrease	False	29.06.2006	5,00%	5,25%	0,25%
04.09.2007	2,8908%			-2259%	2359%	Decrease	True	18.09.2007	5,25%	4,75%	-0,50%
								31.10.2007	4,75%	4,50%	-0,25%
13.11.2007	2,8909%			-950%	1050%	Decrease	True	11.12.2007	4,50%	4,25%	-0,25%
02.01.2008	2,9519%			-1688%	1788%	Decrease	True	22.01.2008	4,25%	3,50%	-0,75%
23.01.2008	2,6936%			-9899%	9999%	Decrease	True	30.01.2008	3,50%	3,00%	-0,50%
03.03.2008	2,7441%			-144%	244%	Decrease	True	18.03.2008	3,00%	2,25%	-0,75%
								30.04.2008	2,25%	2,00%	-0,25%
09.09.2008	2,7390%	398%	-298%			Hike	False	08.10.2008	2,00%	1,50%	-0,50%
09.10.2008	2,2852%	4868%	-4768%			Hike	False	29.10.2008	1,50%	1,00%	-0,50%
01.12.2008	1,5348%	442%	-342%			Hike	False	16.12.2008	1,00%	0,13%	-0,88%
01.12.2015	0,7075%	516%	-416%			Hike	True	17.12.2015	0,13%	0,38%	0,25%
01.12.2016	0,7075%	258%	-158%			Hike	True	15.12.2016	0,38%	0,63%	0,25%

These actions are not considered as they fall on the last day of the month.

Table 80: Probability of Fed Policy Shift: Adjusted Implied Rates

(Bloomberg L.P., 2017 & Federal Reserve, 2016, own graph)

Fed Funds Future Implied Information									FOMC's Monetary Policy Action			
Date of	Implied Rate		Probabilities				Most probable Action	Accuracy of Signal	Date of	Rate level		Effective
observation	before Adj.	after Adj.	0,25 Hike	No change	No Change	0,25 Decrease			action	Before Decision	After Decision	Change
01.10.1990	8,8765%	8,0048%	29,67%	70,33%			No change	False	29.10.1990	8,00%	7,75%	-0,25%
30.10.1990	9,0151%	7,7501%	0,08%	99,92%			No change	False	13.11.1990	7,75%	7,50%	-0,25%
14.11.1990	9,0250%	7,5002%	0,11%	99,89%			No change	False	07.12.1990	7,50%	7,25%	-0,25%
10.12.1990	8,6401%	7,2494%			99,38%	0,62%	No change	False	18.12.1990	7,25%	7,00%	-0,25%
19.12.1990	8,6697%	6,9990%			99,45%	0,55%	No change	False	09.01.1991	7,00%	6,75%	-0,25%
10.01.1991	8,2663%	6,7494%			99,73%	0,27%	No change	False	01.02.1991	6,75%	6,25%	-0,50%
08.02.1991	8,1591%	6,2491%			99,54%	0,46%	No change	False	08.03.1991	6,25%	6,00%	-0,25%
									30.04.1991	6,00%	5,75%	-0,25%
08.07.1991	7,8451%	5,7507%	0,37%	99,63%			No change	False	06.08.1991	5,75%	5,50%	-0,25%
13.08.1991	7,6298%	5,5002%	0,15%	99,85%			No change	False	13.09.1991	5,50%	5,25%	-0,25%
									31.10.1991	5,25%	5,00%	-0,25%
01.11.1991	7,5421%	4,9996%			99,79%	0,21%	No change	False	06.11.1991	5,00%	4,75%	-0,25%
07.11.1991	7,4740%	4,7499%			99,95%	0,05%	No change	False	06.12.1991	4,75%	4,50%	-0,25%
09.12.1991	7,3380%	4,4994%			99,29%	0,71%	No change	False	20.12.1991	4,50%	4,00%	-0,50%
10.03.1992	7,3662%	4,0012%	0,71%	99,29%			No change	False	09.04.1992	4,00%	3,75%	-0,25%
02.06.1992	7,1151%	3,7499%			99,96%	0,04%	No change	False	02.07.1992	3,75%	3,25%	-0,50%
04.08.1992	6,6617%	3,2492%			99,62%	0,38%	No change	False	04.09.1992	3,25%	3,00%	-0,25%
04.01.1994	6,1208%	2,9957%			97,98%	2,02%	No change	False	04.02.1994	3,00%	3,25%	0,25%
23.02.1994	6,3048%	3,2499%			99,86%	0,14%	No change	False	22.03.1994	3,25%	3,50%	0,25%
23.03.1994	6,2466%	3,5001%	0,10%	99,90%			No change	False	18.04.1994	3,50%	3,75%	0,25%
19.04.1994	6,2563%	3,7500%	0,00%	100,00%	100,00%	0,00%	No change	False	17.05.1994	3,75%	4,25%	0,50%
15.07.1994	6,0503%	4,2475%			97,93%	2,07%	No change	False	16.08.1994	4,25%	4,75%	0,50%
18.10.1994	5,8424%	4,7466%			97,31%	2,69%	No change	False	15.11.1994	4,75%	5,50%	0,75%
03.01.1995	5,5618%	5,4951%			97,98%	2,02%	No change	False	01.02.1995	5,50%	6,00%	0,50%
07.06.1995	5,3612%	5,9985%			99,26%	0,74%	No change	False	06.07.1995	6,00%	5,75%	-0,25%
01.12.1995	5,5418%	5,7521%	2,19%	97,81%			No change	False	19.12.1995	5,75%	5,50%	-0,25%
									31.01.1996	5,50%	5,25%	-0,25%
03.03.1997	5,0915%	5,2465%			92,80%	7,20%	No change	False	25.03.1997	5,25%	5,50%	0,25%
01.09.1998	4,9305%	5,4980%			75,85%	24,15%	No change	False	29.09.1998	5,50%	5,25%	-0,25%
01.10.1998	4,9205%	5,2499%			99,92%	0,08%	No change	False	15.10.1998	5,25%	5,00%	-0,25%
02.11.1998	4,8051%	4,9988%			98,93%	1,07%	No change	False	17.11.1998	5,00%	4,75%	-0,25%
									30.06.1999	4,75%	5,00%	0,25%
02.08.1999	4,3842%	4,9998%			99,72%	0,28%	No change	False	24.08.1999	5,00%	5,25%	0,25%
01.11.1999	4,2529%	5,2486%			98,78%	1,22%	No change	False	16.11.1999	5,25%	5,50%	0,25%
03.01.2000	4,1973%	5,4988%			99,48%	0,52%	No change	False	02.02.2000	5,50%	5,75%	0,25%
01.03.2000	4,1006%	5,7497%			99,67%	0,33%	No change	False	21.03.2000	5,75%	6,00%	0,25%
01.05.2000	4,1210%	6,0001%	0,09%	99,91%			No change	False	16.05.2000	6,00%	6,50%	0,50%
01.12.2000	4,1721%	6,5000%	0,00%	100,00%	100,00%	0,00%	No change	False	03.01.2001	6,50%	6,00%	-0,50%
									31.01.2001	6,00%	5,50%	-0,50%
01.03.2001	3,7930%	5,5006%	0,66%	99,34%			No change	False	20.03.2001	5,50%	5,00%	-0,50%
02.04.2001	3,8437%	5,0005%	0,48%	99,52%			No change	False	18.04.2001	5,00%	4,50%	-0,50%
01.05.2001	3,6971%	4,4995%			99,63%	0,37%	No change	False	15.05.2001	4,50%	4,00%	-0,50%
01.06.2001	3,5864%	3,9998%			99,37%	0,63%	No change	False	27.06.2001	4,00%	3,75%	-0,25%
01.08.2001	3,6014%	3,7503%	0,32%	99,68%			No change	False	21.08.2001	3,75%	3,50%	-0,25%
04.09.2001	3,6264%	3,5003%	0,29%	99,71%			No change	False	17.09.2001	3,50%	3,00%	-0,50%
18.09.2001	3,1320%	2,9981%			99,21%	0,79%	No change	False	02.10.2001	3,00%	2,50%	-0,50%
05.10.2001	3,0925%	2,4997%			99,85%	0,15%	No change	False	06.11.2001	2,50%	2,00%	-0,50%
12.11.2001	2,9786%	2,0000%	0,00%	100,00%	100,00%	0,00%	No change	False	11.12.2001	2,00%	1,75%	-0,25%
07.10.2002	2,9875%	1,7504%	0,20%	99,80%			No change	False	06.11.2002	1,75%	1,25%	-0,50%
02.06.2003	2,9773%	1,2516%	3,89%	96,11%			No change	False	25.06.2003	1,25%	1,00%	-0,25%
									30.06.2004	1,00%	1,25%	0,25%
12.07.2004	2,9871%	1,2500%	0,00%	100,00%	100,00%	0,00%	No change	False	10.08.2004	1,25%	1,50%	0,25%
01.09.2004	2,9822%	1,4998%			99,80%	0,20%	No change	False	21.09.2004	1,50%	1,75%	0,25%
11.10.2004	3,0315%	1,7503%	0,15%	99,85%			No change	False	10.11.2004	1,75%	2,00%	0,25%
15.11.2004	3,0562%	2,0000%	0,00%	100,00%	100,00%	0,00%	No change	False	14.12.2004	2,00%	2,25%	0,25%
03.01.2005	3,0779%	2,2501%	0,02%	99,98%			No change	False	02.02.2005	2,25%	2,50%	0,25%
01.03.2005	3,1077%	2,5000%	0,00%	100,00%	100,00%	0,00%	No change	False	22.03.2005	2,50%	2,75%	0,25%
04.04.2005	3,1375%	2,7502%	0,07%	99,93%			No change	False	03.05.2005	2,75%	3,00%	0,25%
									30.06.2005	3,00%	3,25%	0,25%
11.07.2005	3,1425%	3,2500%	0,00%	100,00%	100,00%	0,00%	No change	False	09.08.2005	3,25%	3,50%	0,25%
01.09.2005	3,1425%	3,4999%			99,87%	0,13%	No change	False	20.09.2005	3,50%	3,75%	0,25%
03.10.2005	3,2027%	3,7502%	0,06%	99,94%			No change	False	01.11.2005	3,75%	4,00%	0,25%
14.11.2005	3,1977%	4,0000%	0,00%	100,00%	100,00%	0,00%	No change	False	13.12.2005	4,00%	4,25%	0,25%
									31.01.2006	4,25%	4,50%	0,25%
01.03.2006	3,2028%	4,5000%	0,00%	100,00%	100,00%	0,00%	No change	False	28.03.2006	4,50%	4,75%	0,25%
10.04.2006	3,2485%	4,7501%	0,06%	99,94%			No change	False	10.05.2006	4,75%	5,00%	0,25%
01.06.2006	3,2535%	4,9999%			98,73%	1,27%	No change	False	29.06.2006	5,00%	5,25%	0,25%
04.09.2007	2,8908%	5,2465%			96,52%	3,48%	No change	False	18.09.2007	5,25%	4,75%	-0,50%
									31.10.2007	4,75%	4,50%	-0,25%
13.11.2007	2,8909%	4,4995%			99,66%	0,34%	No change	False	11.12.2007	4,50%	4,25%	-0,25%
02.01.2008	2,9519%	4,2498%			99,78%	0,22%	No change	False	22.01.2008	4,25%	3,50%	-0,75%
23.01.2008	2,6936%	3,4999%			99,35%	0,65%	No change	False	30.01.2008	3,50%	3,00%	-0,50%
03.03.2008	2,7441%	3,0003%	0,25%	99,75%			No change	False	18.03.2008	3,00%	2,25%	-0,75%
									30.04.2008	2,25%	2,00%	-0,25%
09.09.2008	2,7390%	1,9995%			99,72%	0,28%	No change	False	08.10.2008	2,00%	1,50%	-0,50%
09.10.2008	2,2852%	1,4996%			97,80%	2,20%	No change	False	29.10.2008	1,50%	1,00%	-0,50%
01.12.2008	1,5348%	0,9970%			97,51%	2,49%	No change	False	16.12.2008	1,00%	0,13%	-0,88%
01.12.2015	0,7075%	0,1190%			94,72%	5,28%	No change	False	17.12.2015	0,13%	0,38%	0,25%
01.12.2016	0,7075%	0,3748%			99,83%	0,17%	No change	False	15.12.2016	0,38%	0,63%	0,25%

These actions are not considered as they fall on the last day of the month.

7.5.3. Inflation Expectations

Table 81: Results: Trading of TIPS and Inflation Swaps Inflation Expectations before and after Transaction Costs (Bloomberg L.P., 2017, own graph)

TU1 Comdty	Two-years Expected Inflation (Breakeven Rates)														
	10/50 SMA					10/50 LMA					10/50 EMA				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
10.07.2007 - 31.12.2012	0,99867%	1,73393%	0,57596	-0,84934	0,696	0,34027%	1,73495%	0,1961	-1,2292	0,646	0,85306%	1,73424%	0,4919	-0,9334	0,348
01.01.2013 - 28.02.2017	0,38774%	0,76354%	0,50782	0,03964	0,080	-0,22706%	0,76381%	-0,2973	-0,7655	0,507	0,17930%	0,76385%	0,2347	-0,2335	0,047
FV1 Comdty	**Five-years Expected Inflation (Breakeven Rates)**														
	10/50 SMA					10/50 LMA					10/50 EMA				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
10.07.2007 - 31.12.2012	1,88672%	4,65442%	0,40536	-0,88570	0,207	1,87669%	4,65443%	0,4032	-0,8879	0,108	1,82733%	4,65451%	0,3926	-0,8985	0,132
01.01.2013 - 28.02.2017	-0,25191%	2,84767%	-0,08846	-0,32043	0,045	-0,30377%	2,84766%	-0,1067	-0,3386	0,089	-0,10728%	2,84769%	-0,0377	-0,2696	0,032
TY1 Comdty	**Ten-years Expected Inflation (Breakeven Rates)**														
	10/50 SMA					10/50 LMA					10/50 EMA				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
10.07.2007 - 31.12.2012	1,77021%	7,28329%	0,24305	-0,90297	0,991	2,57804%	7,28225%	0,3540	-0,7920	0,804	0,70826%	7,28415%	0,0972	-1,0488	0,802
01.01.2013 - 28.02.2017	2,80714%	4,66988%	0,60112	0,33364	0,207	3,76884%	4,66714%	0,8075	0,5401	0,077	1,11804%	4,67293%	0,2393	-0,0282	0,061

TU1 Comdty	Two-years Expected Inflation (Inflation Swap Rates)														
	10/50 SMA					10/50 LMA					10/50 EMA				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
24.11.2004 - 31.12.2010	0,71568%	1,78914%	0,40001	-0,48569	0,096	0,22747%	1,78966%	0,1271	-0,7586	0,028	-0,55412%	1,76536%	-0,3139	-1,1996	0,429
01.01.2011 - 26.10.2016	0,12110%	0,72634%	0,16673	-0,58161	0,230	0,21043%	0,72625%	0,2898	-0,4586	0,647	-0,06940%	0,67863%	-0,1023	-0,8506	0,264
FV1 Comdty	**Five-years Expected Inflation (Inflation Swap Rates)**														
	10/50 SMA					10/50 LMA					10/50 EMA				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
24.11.2004 - 31.12.2010	1,08212%	4,48001%	0,24154	-0,47709	0,267	2,11217%	4,47849%	0,4716	-0,2470	0,265	1,50093%	4,47950%	0,3351	-0,3836	0,578
01.01.2011 - 26.10.2016	-0,51188%	2,88125%	-0,17766	-0,99014	0,405	-0,62791%	2,88116%	-0,2179	-1,0304	0,432	-1,54240%	2,87984%	-0,5356	-1,3481	0,514
TY1 Comdty	**Ten-years Expected Inflation (Inflation Swap Rates)**														
	10/50 SMA					10/50 LMA					10/50 EMA				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
24.11.2004 - 31.12.2010	-4,90539%	6,78093%	-0,72341	-1,32591	0,949	-0,89847%	6,78755%	-0,1324	-0,7349	0,710	-2,30808%	6,78638%	-0,3401	-0,9426	0,739
01.01.2011 - 26.10.2016	0,86613%	4,91202%	0,17633	-0,67752	0,740	0,29333%	4,91239%	0,0597	-0,7941	0,446	-0,21728%	4,91244%	-0,0442	-0,8981	0,492

01.01.2013-28.02.2017	Two- and Ten-years Expected Inflation (Breakeven Rates) after Transaction Costs											
	10/50 SMA & TU1 Comdty				10/50 SMA & TY1 Comdty				10/50 LMA & TY1 Comdty			
Cost per Trade	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
0,03%	0,20844%	0,76418%	0,27276	-0,2350613	2,54221%	4,66503%	0,54495	-0,0561647	3,44162%	4,66244%	0,73816	-0,0693698
0,02%	0,26641%	0,76418%	0,34862	-0,1592002	2,59906%	4,66503%	0,55714	-0,0439795	3,51891%	4,66244%	0,75474	-0,0527921
0,01%	0,32441%	0,76418%	0,42452	-0,0833030	2,65593%	4,66503%	0,56933	-0,0317888	3,59626%	4,66244%	0,77132	-0,0362037

7.5.4. Conventional Monetary Policy Announcements/Changes

Table 82: Impact of FOMC Interest Rate Decisions on US 3-month T-Bill Future

(Bloomberg L.P., 2017 and Federal Reserve, 2016 and 2017, own graph)

United States						
Fed Funds Rate						
FOMC Statement as of*	Increase (bps)	Decrease (bps)	Level	ED1 Comdty		
				Announcement day	1 day after	between Announcements
30.06.1999	25		5,00%	0,09%	0,05%	-0,01%
24.08.1999	25		5,25%	-0,01%	0,02%	0,08%
16.11.1999	25		5,50%	-0,06%	0,03%	0,05%
02.02.2000	25		5,75%	0,00%	0,03%	0,06%
21.03.2000	25		6,00%	0,00%	0,02%	-0,10%
16.05.2000	50		6,50%	-0,06%	-0,01%	0,31%
03.01.2001		50	6,00%	0,08%	0,21%	0,41%
31.01.2001		50	5,50%	0,06%	0,02%	-0,04%
20.03.2001		50	5,00%	0,06%	0,07%	-0,14%
18.04.2001		50	4,50%	0,32%	-0,01%	0,28%
15.05.2001		50	4,00%	0,11%	-0,01%	0,07%
27.06.2001		25	3,75%	-0,09%	-0,09%	-0,02%
21.08.2001		25	3,50%	0,07%	-0,02%	0,14%
17.09.2001		50	3,00%	0,12%	0,05%	0,27%
02.10.2001		50	2,50%	0,11%	-0,01%	0,13%
06.11.2001		50	2,00%	0,15%	0,02%	0,11%
11.12.2001		25	1,75%	0,08%	0,01%	-0,02%
06.11.2002		50	1,25%	0,02%	-0,01%	0,04%
25.06.2003		25	1,00%	-0,14%	-0,13%	-0,05%
30.06.2004	25		1,25%	0,12%	0,06%	0,00%
10.08.2004	25		1,50%	-0,07%	0,02%	-0,02%
21.09.2004	25		1,75%	-0,04%	-0,01%	-0,06%
10.11.2004	25		2,00%	-0,04%	0,00%	-0,02%
14.12.2004	25		2,25%	0,00%	0,00%	-0,04%
02.02.2005	25		2,50%	-0,01%	0,01%	-0,02%
22.03.2005	25		2,75%	-0,04%	-0,01%	-0,02%
03.05.2005	25		3,00%	-0,01%	0,02%	0,00%
30.06.2005	25		3,25%	-0,03%	-0,10%	-0,01%
09.08.2005	25		3,50%	0,03%	-0,01%	-0,03%
20.09.2005	25		3,75%	-0,09%	0,03%	-0,02%
01.11.2005	25		4,00%	-0,04%	-0,02%	0,01%
13.12.2005	25		4,25%	0,04%	0,07%	-0,01%
31.01.2006	25		4,50%	0,00%	-0,06%	-0,04%
28.03.2006	25		4,75%	-0,07%	-0,02%	-0,03%
10.05.2006	25		5,00%	-0,01%	0,00%	0,04%
29.06.2006	25		5,25%	0,07%	0,03%	0,33%
18.09.2007		50	4,75%	0,21%	0,06%	0,12%
31.10.2007		25	4,50%	-0,05%	0,01%	-0,01%
11.12.2007		25	4,25%	-0,12%	0,15%	0,17%
22.01.2008		75	3,50%	0,47%	0,11%	0,53%
30.01.2008		50	3,00%	0,08%	0,05%	0,57%
18.03.2008		75	2,25%	-0,23%	0,01%	-0,47%
30.04.2008		25	2,00%	0,12%	-0,03%	0,83%
08.10.2008		50	1,50%	-0,13%	-0,08%	0,54%
29.10.2008		50	1,00%	0,08%	0,03%	0,65%
16.12.2008		75-100	0-0,25%	0,32%	-0,02%	0,79%
17.12.2015	0-25		0,25-0,50%	-0,03%	-0,01%	0,08%
14.12.2016	0-25		0,50-0,75%	-0,03%	0,01%	

*Interest rate decisions have an immediate effect, with exception of announcement on 14.12.2016, with effect not before the day following the announcement

Table 83: Results: US Interest Rate Decisions Trading before Transaction Costs (Bloomberg L.P., 2017 and Federal Reserve, 2017, own graph)

According to Date of Announcement/Change	**United States**														
	FF1 Comdty (Thirty-days Future)					ED1 Comdty (Three-month Future)					TU1 Comdty (Two-year future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
05.01.1999 - 03.03.2017	0,18583%	0,28593%	0,64989	-0,3105481	0,004	0,64244%	0,68385%	0,93944	0,0502652	0,009	1,11000%	1,55786%	0,71252	-0,0630731	0,010
14.01.2000 - 09.03.2000	0,17169%	0,16995%	1,01021	-1,2333455	0,069	-0,85802%	0,32624%	-2,63005	-3,3601180	1,000	-2,75325%	1,60333%	-1,71721	-1,7172055	0,991
15.01.2001 - 09.03.2001	-0,68051%	0,12966%	-5,24848	0,0000000	1,000	3,24802%	0,87768%	3,70067	0,0000000	0,000	3,37917%	1,57199%	2,14962	0,0000000	0,008
18.10.2002 - 12.12.2002	1,38588%	0,40864%	3,39141	0,0000000	0,000	4,16703%	0,93224%	4,46992	0,0000000	0,000	6,11097%	1,90079%	3,21497	0,0000000	0,000
15.07.2004 - 08.09.2004	-0,06564%	0,06718%	-0,97711	-0,0003953	0,891	1,12817%	0,78318%	1,44049	1,0195429	0,038	-0,47985%	1,98835%	-0,24133	-1,7189008	0,595
15.10.2007 - 07.12.2007	0,88511%	0,33253%	2,66175	0,0000000	0,001	-0,40732%	0,71381%	-0,57063	0,0000000	0,796	10,53527%	2,40284%	4,38450	0,0000000	0,000
	FV1 Comdty (Five-year Future)					TY1 Comdty (Ten-year Future)					US1 Comdty (Thirty-year Future)				
	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
	2,06447%	3,96716%	0,52039	-0,1405376	0,017	2,27253%	6,06678%	0,37459	-0,2147255	0,019	1,95535%	10,05934%	0,19438	-0,2037511	0,046
	-1,42847%	3,77226%	-0,37868	-1,1855337	0,690	5,80577%	6,40895%	0,90588	-0,9368023	0,099	33,01215%	9,99768%	3,30198	-1,1789322	0,000
	6,42553%	3,33723%	1,92541	0,0000000	0,010	6,42553%	3,33723%	1,92541	0,0000000	0,017	16,86437%	9,12355%	1,84844	0,0000000	0,019
	9,72957%	4,90961%	1,98174	0,0000000	0,004	13,76949%	7,00947%	1,96441	0,0000000	0,003	27,20252%	11,48095%	2,36936	0,0000000	0,000
	-2,33662%	4,38290%	-0,53312	-2,5441348	0,751	-2,04580%	6,07317%	-0,33686	-2,5151406	0,649	-4,01079%	9,13152%	-0,43923	-2,6506497	0,704
	22,92914%	4,87004%	4,70820	0,0000000	0,000	22,92914%	4,87004%	4,70820	0,0000000	0,000	31,09915%	9,99778%	3,11061	0,0000000	0,000

Table 84: Impact of ECB Interest Rate Decisions on Euribor 3-month Future (Bloomberg L.P., 2017 and European Central Bank, 2017a, own graph)

European Union

Deposit Facility Rate

ECB Statement as of*	Increase (bps)	Decrease (bps)	Level	ER1 Comdty: Announcement day	ER1 Comdty: 1 day after	ER1 Comdty: between Announcements
04.11.1999	50		2,00%	0,06%	0,02%	-0,09%
03.02.2000	25		2,25%	0,04%	0,01%	-0,10%
16.03.2000	25		2,50%	0,05%	0,02%	-0,01%
27.04.2000	25		2,75%	-0,04%	-0,02%	-0,23%
08.06.2000	50		3,25%	-0,25%	0,06%	-0,26%
31.08.2000	25		3,50%	0,05%	0,04%	0,20%
05.10.2000	25		3,75%	-0,05%	0,01%	0,21%
10.05.2001		25	3,50%	0,18%	-0,01%	0,27%
30.08.2001		25	3,25%	0,01%	-0,02%	0,23%
17.09.2001		50	2,75%	-0,01%	0,17%	0,49%
08.11.2001		50	2,25%	-0,01%	-0,01%	0,41%
05.12.2002		50	1,75%	0,07%	-0,01%	0,32%
06.03.2003		25	1,50%	-0,08%	0,02%	0,06%
05.06.2003		50	1,00%	0,03%	-0,01%	-0,27%
01.12.2005	25		1,25%	0,04%	0,04%	0,00%
02.03.2006	25		1,50%	0,00%	-0,01%	-0,07%
08.06.2006	25		1,75%	0,07%	0,02%	0,01%
03.08.2006	25		2,00%	-0,05%	0,02%	-0,11%
05.10.2006	25		2,25%	0,00%	0,00%	0,06%
07.12.2006	25		2,50%	-0,04%	-0,01%	-0,06%
08.03.2007	25		2,75%	-0,04%	-0,03%	-0,27%
06.06.2007	25		3,00%	0,02%	-0,01%	-1,67%
03.07.2008	25		3,25%	0,06%	0,01%	0,72%
08.10.2008		25	2,75%	0,03%	-0,02%	
09.10.2008	50		3,25%	-0,02%	0,33%	0,74%
06.11.2008		50	2,75%	0,06%	-0,03%	0,33%
04.12.2008		75	2,00%	-0,06%	0,03%	0,94%
15.01.2009		100	1,00%	-0,06%	0,04%	0,35%
05.03.2009		50	0,50%	-0,04%	-0,02%	0,22%
02.04.2009		25	0,25%	-0,12%	-0,02%	0,54%
07.04.2011	25		0,50%	-0,03%	-0,03%	-0,02%
07.07.2011	25		0,75%	0,00%	0,03%	0,11%
03.11.2011		25	0,50%	0,09%	-0,08%	0,02%
08.12.2011		25	0,25%	-0,11%	-0,03%	0,31%
05.07.2012		25	0,00%	0,05%	0,00%	0,33%
05.06.2014		10	-0,10%	0,02%	-0,03%	0,08%
04.09.2014		10	-0,20%	0,04%	0,01%	0,32%
03.12.2015		10	-0,30%	-0,07%	0,00%	0,04%
10.03.2016		10	-0,40%	-0,04%	0,00%	

*Up to announcement of 05.06.2003 interest rate changed the day following the announcement; from 01.12.2005 on, with exception of announcements of 08.10 & 09.10.2008 (both with an immediate effect), interest rate changed one week after the announcement

Main Refinancing Operation (MRO) Rate

ECB Statement as of*	Increase (bps)	Decrease (bps)	Level	ER1 Comdty: Announcement day	ER1 Comdty: 1 day after	ER1 Comdty: between Announcements
03.07.2008	25		4,25%	-0,01%	-0,01%	0,72%
08.10.2008		50	3,75%	0,02%	-0,03%	0,76%
06.11.2008		50	3,25%	0,02%	-0,01%	0,33%
04.12.2008		75	2,50%	0,00%	-0,02%	0,94%
15.01.2009		50	2,00%	-0,02%	-0,04%	0,35%
05.03.2009		50	1,50%	0,04%	0,03%	0,22%
02.04.2009		25	1,25%	0,01%	0,04%	0,00%
07.05.2009		25	1,00%	0,05%	0,02%	0,54%
07.04.2011	25		1,25%	-0,03%	-0,03%	0,02%
07.07.2011	25		1,50%	0,00%	0,03%	0,11%
03.11.2011		25	1,25%	0,09%	-0,08%	0,02%
08.12.2011		25	1,00%	-0,11%	-0,03%	0,31%
05.07.2012		25	0,75%	0,05%	0,00%	0,32%
02.05.2013		25	0,50%	0,02%	-0,02%	0,03%
07.11.2013		25	0,25%	0,03%	-0,01%	-0,02%
05.06.2014		10	0,15%	0,02%	-0,03%	0,08%
04.09.2014		10	0,05%	0,04%	0,01%	0,37%
10.03.2016		5	0,00%	-0,04%	0,00%	

*all interest rate decisions from 03.07.2008 on implemented one week after the announcement

Table 85: Results: EU Interest Rate Decisions Trading before Transaction Costs (Bloomberg L.P., 2017 and European Central Bank, 2017a, own graph)

European Union (Deposit Facility Rate) — According to Date of Announcement

	ER1 Comdty (Three-month Future)					DU1 Comdty (Two-year Future)					OE1 Comdty (Five-year Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.10.1999 - 03.03.2017	0,34357%	0,40834%	0,84138	0,2834500	0,343	0,51898%	1,25959%	0,41202	-0,3052758	0,448	1,26240%	3,23731%	0,38995	-0,4355896	0,368
16.12.1999 - 09.02.2000	-0,00005%	0,36097%	-0,00013	-0,0001258	0,511	-0,62216%	1,29458%	-0,48059	0,5831418	0,879	-3,63640%	3,24440%	-1,12082	0,2205234	0,999
22.02.2000 - 17.04.2000	-0,00097%	0,43667%	-0,00222	-0,0022191	0,829	1,25689%	1,25215%	1,00379	-1,6961813	0,017	3,34655%	2,79872%	1,19574	-1,3501499	0,000
17.05.2000 - 11.07.2000	-0,33826%	0,84742%	-0,39916	-0,8786000	0,000	1,52215%	1,69353%	0,89880	0,2232587	0,000	7,99709%	3,17426%	2,51935	1,2072727	0,048
19.09.2002 - 13.11.2002	0,90145%	0,58923%	1,52987	0,0000000	0,000	2,74885%	1,80938%	1,51922	0,0000000	0,000	2,99689%	4,21943%	0,71026	0,0000000	0,043
20.02.2003 - 16.04.2003	-0,72727%	0,59286%	-1,22673	0,0000000	0,999	-1,69385%	1,97280%	-0,85860	0,0000000	0,974	-8,00114%	4,70892%	-1,69915	0,0000000	1,000

RX1 Comdty (Ten-year Future)					UB1 Comdty (Thirty-year Future)				
Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
2,27661%	5,40854%	0,42093	-0,3579844	0,482	3,38078%	11,03159%	0,30646	-0,2611531	0,381
-8,32459%	6,32359%	-1,31643	-0,0527787	0,805	-4,95577%	11,78163%	-0,42064	-0,9579506	0,503
10,70657%	5,40205%	1,98194	-1,0729019	0,000	22,01814%	9,68832%	2,27265	-0,1623525	0,000
21,78830%	4,78407%	4,55434	1,9823316	0,273	41,38486%	9,27769%	4,46069	3,6069156	0,967
1,38462%	6,16927%	0,22444	0,0000000	0,289	-7,43454%	9,09601%	-0,81734	0,0000000	0,968
-6,97903%	6,76819%	-1,03115	0,0000000	0,994	-11,64813%	10,05827%	-1,15806	0,0000000	0,995

European Union (MRO) — According to Date of Announcement

	ER1 Comdty (Three-month Future)					DU1 Comdty (Two-year Future)					OE1 Comdty (Five-year Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.07.2008 - 03.03.2017	0,38299%	0,38421%	0,99682	-0,4780826	0,766	0,33157%	1,11665%	0,29694	-1,0235590	0,583	1,21286%	3,24621%	0,37362	-0,9461298	0,601
15.09.2008 - 07.11.2008	9,02694%	1,61421%	5,59217	0,0000000	0,000	13,87985%	3,21427%	4,31819	0,0000000	0,000	22,48239%	6,65689%	3,37731	0,0000000	0,000
20.11.2008 - 14.01.2009	5,69909%	0,84513%	6,74344	0,0000000	0,000	6,88030%	1,96822%	3,49570	0,0000000	0,000	13,11471%	5,04197%	2,60111	0,0000000	0,000
13.02.2009 - 09.04.2009	1,72907%	0,50627%	3,41532	0,0000000	0,000	-2,47993%	1,93568%	-1,28117	0,0000000	0,957	-7,28307%	5,11607%	-1,42357	0,0000000	0,991
20.06.2011 - 12.08.2011	-2,01326%	0,53673%	-3,75094	-7,4428558	1,000	-7,60418%	2,22254%	-3,42140	-8,3138786	1,000	-12,38850%	6,03672%	-2,05219	-6,3581456	1,000
21.11.2011 - 13.01.2012	0,96239%	0,52695%	1,82636	0,0000000	0,008	2,91512%	1,00189%	2,90962	0,0000000	0,000	11,51465%	4,24265%	2,71402	0,0000000	0,000

RX1 Comdty (Ten-year Future)					UB1 Comdty (Thirty-year Future)				
Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
2,15824%	5,96594%	0,36176	-0,7719783	0,721	1,86854%	13,04634%	0,14322	-0,6091243	0,515
13,66250%	9,25197%	1,47671	0,0000000	0,023	31,30037%	21,96552%	1,42498	0,0000000	0,010
27,71930%	8,59065%	3,22668	0,0000000	0,000	15,26764%	19,20989%	0,79478	0,0000000	0,102
-10,45746%	8,92442%	-1,17178	0,0000000	0,986	-32,40479%	15,81097%	-2,04951	0,0000000	1,000
-18,09787%	9,21325%	-1,96433	-6,6636262	1,000	-18,69431%	17,73227%	-1,05425	-5,5801596	0,931
12,04702%	8,05144%	1,49626	0,0000000	0,000	36,47923%	15,42665%	2,36469	0,0000000	0,000

Table 86: Impact of ECB Interest Rate Changes on Euribor 3-month Future (Bloomberg L.P., 2017 and European Central Bank, 2017b, own graph)

European Union

Deposit Facility Rate

Date of Change	Increase (bps)	Decrease (bps)	Level	ER1 Comdty Day of Change	ER1 Comdty 1 day after	ER1 Comdty between Changes
05.11.1999	50		2,00%	0,02%	0,04%	-0,10%
04.02.2000	25		2,25%	0,01%	-0,02%	-0,09%
17.03.2000	25		2,50%	0,02%	0,03%	-0,10%
28.04.2000	25		2,75%	-0,02%	0,00%	-0,44%
09.06.2000	50		3,25%	0,06%	0,01%	0,04%
01.09.2000	25		3,50%	0,04%	-0,01%	0,09%
06.10.2000	25		3,75%	0,01%	0,03%	0,44%
11.05.2001		25	3,50%	-0,01%	-0,01%	0,09%
31.08.2001		25	3,25%	-0,02%	-0,01%	0,22%
18.09.2001		50	2,75%	0,17%	0,06%	0,49%
09.11.2001		50	2,25%	-0,01%	0,02%	0,49%
06.12.2002		50	1,75%	-0,01%	-0,01%	0,18%
07.03.2003		25	1,50%	0,02%	0,02%	0,16%
06.06.2003		50	1,00%	-0,01%	0,00%	-0,24%
06.12.2005	25		1,25%	0,02%	-0,01%	-0,05%
08.03.2006	25		1,50%	-0,01%	0,01%	0,02%
15.06.2006	25		1,75%	-0,02%	0,00%	-0,12%
09.08.2006	25		2,00%	-0,02%	0,01%	-0,09%
11.10.2006	25		2,25%	0,00%	0,00%	0,02%
13.12.2006	25		2,50%	0,01%	-0,02%	-0,06%
14.03.2007	25		2,75%	0,02%	-0,02%	-0,20%
13.06.2007	25		3,00%	0,01%	0,01%	-1,60%
09.07.2008	25		3,25%	0,01%	0,00%	0,64%
08.10.2008		25	2,75%	0,03%	-0,02%	
09.10.2008	50		3,25%	-0,02%	0,33%	0,98%
12.11.2008		50	2,75%	0,04%	-0,09%	0,18%
10.12.2008		75	2,00%	0,06%	0,02%	0,93%
21.01.2009		100	1,00%	0,04%	0,03%	0,23%
11.03.2009		50	0,50%	0,02%	0,01%	0,22%
08.04.2009		25	0,25%	0,01%	-0,02%	0,56%
13.04.2011	25		0,50%	-0,01%	0,01%	0,11%
13.07.2011	25		0,75%	-0,01%	0,01%	-0,03%
09.11.2011		25	0,50%	0,01%	0,02%	-0,08%
14.12.2011		25	0,25%	-0,01%	0,01%	0,49%
11.07.2012		25	0,00%	0,02%	0,04%	0,28%
11.06.2014		10	-0,10%	0,03%	0,01%	0,14%
10.09.2014		10	-0,20%	0,00%	0,00%	0,23%
09.12.2015		10	-0,30%	-0,01%	0,00%	0,03%
16.03.2016		10	-0,40%	0,00%	0,00%	

Main Refinancing Operation (MRO) Rate

Date of Change	Increase (bps)	Decrease (bps)	Level	ER1 Comdty Day of Change	ER1 Comdty 1 day after	ER1 Comdty between Changes
09.07.2008	25		4,25%	0,01%	0,00%	1,11%
15.10.2008		50	3,75%	-0,14%	0,16%	0,54%
12.11.2008		50	3,25%	0,04%	-0,09%	0,18%
10.12.2008		75	2,50%	0,06%	0,02%	0,93%
21.01.2009		50	2,00%	0,04%	0,03%	0,23%
11.03.2009		50	1,50%	0,02%	0,01%	0,22%
08.04.2009		25	1,25%	0,01%	-0,02%	0,10%
13.05.2009		25	1,00%	0,01%	0,01%	0,47%
13.04.2011	25		1,25%	-0,01%	0,01%	0,11%
13.07.2011	25		1,50%	-0,01%	0,01%	-0,03%
09.11.2011		25	1,25%	0,01%	0,02%	-0,08%
14.12.2011		25	1,00%	-0,01%	0,01%	0,49%
11.07.2012		25	0,75%	0,02%	0,04%	0,26%
08.05.2013		25	0,50%	0,00%	0,00%	0,06%
13.11.2013		25	0,25%	0,01%	0,00%	-0,03%
11.06.2014		10	0,15%	0,03%	0,01%	0,14%
10.09.2014		10	0,05%	0,00%	0,00%	0,26%
16.03.2016		5	0,00%	0,00%	0,00%	

Table 87: Results: EU Interest Rate Changes Trading before Transaction Costs (Bloomberg L.P., 2017 and European Central Bank, 2017b, own graph)

According to Date of Change — European Union (Deposit Facility Rate)

Period	ER1 Comdty (Three-month Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	DU1 Comdty (Two-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	OE1 Comdty (Five-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.10.1999 - 03.03.2017	0,33748%	0,40836%	0,82642	0,2684972	0,426	0,50747%	1,25961%	0,40288	-0,3144173	0,545	1,28362%	3,23728%	0,39651	-0,4290322	0,452
16.12.1999 - 09.02.2000	-0,20140%	0,36073%	-0,55832	-0,5583184	0,904	-1,13347%	1,29309%	-0,87656	0,1871697	0,970	-4,47331%	3,23968%	-1,38079	-0,0394443	1,000
22.02.2000 - 17.04.2000	0,33582%	0,43612%	0,77002	0,7700228	0,029	1,01067%	1,25310%	0,80654	-1,8934326	0,026	3,08781%	2,79995%	1,10281	-1,4430845	0,004
17.05.2000 - 11.07.2000	-0,20346%	0,84760%	-0,24004	-0,7194757	0,748	1,64665%	1,69304%	0,97260	0,2970567	0,004	7,45454%	3,17936%	2,34467	1,0325880	0,000
19.09.2002 - 13.11.2002	0,90145%	0,58923%	1,52987	0,0000000	0,001	2,74885%	1,80938%	1,51922	0,0000000	0,000	2,99689%	4,21943%	0,71026	0,0000000	0,050
20.02.2003 - 16.04.2003	-0,72727%	0,59286%	-1,22673	0,0000000	0,996	-1,69385%	1,97280%	-0,85860	0,0000000	0,972	-8,00114%	4,70892%	-1,69915	0,0000000	1,000

Period	RX1 Comdty (Ten-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	UB1 Comdty (Thirty-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.10.1999 - 03.03.2017	2,28070%	5,40853%	0,42169	-0,3572273	0,520	3,40480%	11,03155%	0,30864	-0,2589743	0,431
16.12.1999 - 09.02.2000	-11,40984%	6,29981%	-1,81114	-0,5474840	1,000	-11,97334%	11,75852%	-1,01827	-1,5555841	0,988
22.02.2000 - 17.04.2000	9,78657%	5,40861%	1,80944	-1,2454045	0,000	20,94140%	9,69614%	2,15977	-0,2752325	0,000
17.05.2000 - 11.07.2000	21,58674%	4,78701%	4,50945	1,9374346	0,000	30,86656%	9,38862%	3,28766	2,4338855	0,000
19.09.2002 - 13.11.2002	1,38462%	6,16927%	0,22444	0,0000000	0,293	-7,43454%	9,09601%	-0,81734	0,0000000	0,967
20.02.2003 - 16.04.2003	-6,97903%	6,76819%	-1,03115	0,0000000	0,988	-11,64813%	10,05827%	-1,15806	0,0000000	0,997

According to Date of Change — European Union (MRO)

Period	ER1 Comdty (Three-month Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	DU1 Comdty (Two-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	OE1 Comdty (Five-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.07.2008 - 03.03.2017	0,29004%	0,38453%	0,75426	-0,7206446	0,468	0,29417%	1,11669%	0,26343	-1,0570697	0,498	1,39579%	3,24591%	0,43002	-0,8897393	0,625
15.09.2008 - 07.11.2008	9,02694%	1,61421%	5,59217	0,0000000	0,000	13,87985%	3,21427%	4,31819	0,0000000	0,000	22,48239%	6,65689%	3,37731	0,0000000	0,000
20.11.2008 - 14.01.2009	5,69909%	0,84513%	6,74344	0,0000000	0,000	6,88030%	1,96822%	3,49570	0,0000000	0,000	13,11471%	5,04197%	2,60111	0,0000000	0,000
13.02.2009 - 09.04.2009	1,72907%	0,50627%	3,41532	0,0000000	0,000	-2,47993%	1,93568%	-1,28117	0,0000000	0,999	-7,28307%	5,11607%	-1,42357	0,0000000	1,000
20.06.2011 - 12.08.2011	-1,11487%	0,54812%	-2,03400	-5,7259114	1,000	-3,52517%	2,26980%	-1,55307	-6,4455578	1,000	-5,99252%	6,08427%	-0,98492	-5,2908762	0,988
21.11.2011 - 13.01.2012	0,96239%	0,52695%	1,82636	0,0000000	0,000	2,91512%	1,00189%	2,90962	0,0000000	0,000	11,51465%	4,24265%	2,71402	0,0000000	0,000

Period	RX1 Comdty (Ten-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	UB1 Comdty (Thirty-year Future) Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.07.2008 - 03.03.2017	2,62088%	5,96518%	0,43936	-0,6943762	0,794	3,21557%	13,04500%	0,24650	-0,5058497	0,789
15.09.2008 - 07.11.2008	13,66250%	9,25197%	1,47671	0,0000000	0,001	31,30037%	21,96552%	1,42498	0,0000000	0,000
20.11.2008 - 14.01.2009	27,71930%	8,59065%	3,22668	0,0000000	0,000	15,26764%	19,20989%	0,79478	0,0000000	0,023
13.02.2009 - 09.04.2009	-10,45746%	8,92442%	-1,17178	0,0000000	0,998	-32,40479%	15,81097%	-2,04951	0,0000000	1,000
20.06.2011 - 12.08.2011	-9,61135%	9,28018%	-1,03569	-5,7349806	0,993	-8,37926%	17,77046%	-0,47153	-4,9974333	0,843
21.11.2011 - 13.01.2012	12,04702%	8,05144%	1,49626	0,0000000	0,000	36,47923%	15,42665%	2,36469	0,0000000	0,000

Table 88: Impact of RBA Interest Rate Decisions on AUS 3-month Future

(Bloomberg L.P., 2017 and Reserve Bank of Australia, 2017b, own graph)

Australia						
Cash Rate						
RBA Statement as of*	Increase (bps)	Decrease (bps)	Level	IR1 Comdty		
				Announcement day	1 day after	between Announcements
03.11.1999	25		5,00%	-0,02%	0,06%	-0,15%
02.02.2000	50		5,50%	-0,28%	0,02%	-0,07%
05.04.2000	25		5,75%	0,00%	-0,01%	-0,10%
03.05.2000	25		6,00%	-0,03%	0,01%	0,10%
02.08.2000	25		6,25%	-0,11%	0,00%	0,84%
07.02.2001		50	5,75%	-0,03%	-0,01%	0,10%
07.03.2001		25	5,50%	0,13%	0,02%	0,23%
04.04.2001		50	5,00%	0,17%	-0,07%	-0,24%
05.09.2001		25	4,75%	-0,02%	0,01%	0,56%
03.10.2001		25	4,50%	-0,06%	-0,01%	-0,06%
05.12.2001		25	4,25%	-0,03%	-0,02%	-0,52%
08.05.2002	25		4,50%	-0,12%	-0,04%	-0,28%
05.06.2002	25		4,75%	0,02%	0,02%	-0,10%
05.11.2003	25		5,00%	-0,17%	-0,04%	-0,25%
03.12.2003	25		5,25%	-0,02%	-0,01%	-0,40%
02.03.2005	25		5,50%	0,01%	0,00%	0,00%
03.05.2006	25		5,75%	-0,07%	-0,01%	-0,28%
02.08.2006	25		6,00%	-0,01%	0,02%	-0,14%
08.11.2006	25		6,25%	0,01%	0,01%	0,04%
08.08.2007	25		6,50%	-0,02%	-0,01%	-0,78%
07.11.2007	25		6,75%	0,00%	0,00%	-0,33%
05.02.2008	25		7,00%	0,01%	0,00%	-0,53%
04.03.2008	25		7,25%	0,03%	-0,04%	1,01%
02.09.2008		25	7,00%	-0,02%	0,02%	0,71%
07.10.2008		100	6,00%	0,97%	0,17%	1,22%
04.11.2008		75	5,25%	0,49%	0,06%	0,61%
02.12.2008		100	4,25%	-0,02%	-0,06%	0,39%
03.02.2009		100	3,25%	-0,13%	-0,08%	-0,66%
07.04.2009		25	3,00%	-0,02%	-0,02%	-0,81%
06.10.2009	25		3,25%	-0,07%	-0,02%	-0,28%
03.11.2009	25		3,50%	0,16%	-0,02%	0,20%
01.12.2009	25		3,75%	-0,04%	-0,01%	0,07%
02.03.2010	25		4,00%	-0,05%	0,00%	-0,10%
06.04.2010	25		4,25%	-0,06%	0,02%	-0,10%
04.05.2010	25		4,50%	0,01%	0,00%	0,06%
02.11.2010	25		4,75%	-0,13%	-0,01%	0,07%
01.11.2011		25	4,50%	0,07%	0,04%	-0,02%
06.12.2011		25	4,25%	0,06%	-0,01%	-0,31%
01.05.2012		50	3,75%	0,19%	-0,04%	0,66%
05.06.2012		25	3,50%	-0,19%	-0,03%	-0,66%
02.10.2012		25	3,25%	0,02%	0,05%	-0,04%
04.12.2012		25	3,00%	0,01%	-0,02%	0,04%
07.05.2013		25	2,75%	0,08%	0,02%	0,21%
06.08.2013		25	2,50%	-0,06%	0,03%	-0,04%
03.02.2015		25	2,25%	0,13%	-0,07%	0,12%
05.05.2015		25	2,00%	-0,02%	-0,02%	-0,43%
03.05.2016		25	1,75%	0,10%	-0,02%	0,17%
02.08.2016		25	1,50%	0,06%	-0,01%	

*Up to announcement of 07.11.2007, interest rate change with immediate effect; announcement day = day of change
From 05.02.2008 on, interest rate change one day after announcement

Table 89: Results: AUS Interest Rate Decisions Trading before Transaction Costs

(Bloomberg L.P., 2017 and Reserve Bank of Australia, 2017b, own graph)

According to Date of Announcement	Australia									
	IR1 Comdty (Three-month Future)					XM1 Comdty (Ten-year Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
05.01.1999 - 03.03.2017	0,09540%	0,68032%	0,14023	0,1910015	0,346	-0,17138%	1,05401%	-0,16260	-0,3563743	0,117
20.03.2000 - 12.05.2000	-0,62656%	0,92815%	-0,67506	0,8842307	0,933	2,57817%	1,13227%	2,27699	2,2164221	0,000
15.01.2001 - 09.03.2001	2,55107%	0,79332%	0,14023	0,1910015	0,000	2,73006%	0,87941%	3,10442	0,0000000	0,000
20.08.2001 - 12.10.2001	3,93584%	1,00058%	3,93356	0,0000000	0,000	2,07559%	1,15715%	1,79371	0,0000000	0,000
15.04.2002 - 07.06.2002	0,19508%	0,58841%	0,33153	1,3725376	0,237	-0,79264%	1,00320%	-0,79010	-2,5666771	0,955
10.11.2003 - 02.01.2004	-0,13888%	0,42910%	-0,32365	0,6383913	0,760	-1,87583%	1,02761%	-1,82543	-3,5414592	1,000

Table 90: Impact of RBA Interest Rate Changes on AUS 3-month Future

(Bloomberg L.P., 2017 and Reserve Bank of Australia, 2017a, own graph)

Australia						
Cash Rate						
Date of Change*	Increase (bps)	Decrease (bps)	Level	IR1 Comdty		
				Day of Change	1 day after	between Changes
06.02.2008	25		7,00%	0,00%	-0,04%	-0,51%
05.03.2008	25		7,25%	-0,04%	-0,09%	0,96%
03.09.2008		25	7,00%	0,02%	-0,03%	1,71%
08.10.2008		100	6,00%	0,17%	0,00%	0,75%
05.11.2008		75	5,25%	0,06%	0,06%	0,09%
03.12.2008		100	4,25%	-0,06%	-0,10%	0,28%
04.02.2009		100	3,25%	-0,08%	-0,05%	-0,54%
08.04.2009		25	3,00%	-0,02%	0,04%	-0,87%
07.10.2009	25		3,25%	-0,02%	-0,10%	-0,05%
04.11.2009	25		3,50%	-0,02%	-0,03%	0,00%
02.12.2009	25		3,75%	-0,01%	0,01%	0,06%
03.03.2010	25		4,00%	0,00%	0,03%	-0,11%
07.04.2010	25		4,25%	0,02%	0,02%	-0,02%
05.05.2010	25		4,50%	0,00%	-0,02%	-0,07%
03.11.2010	25		4,75%	-0,01%	0,00%	0,28%
02.11.2011		25	4,50%	0,04%	0,00%	-0,03%
07.12.2011		25	4,25%	-0,01%	0,01%	-0,19%
02.05.2012		50	3,75%	-0,04%	0,02%	0,28%
06.06.2012		25	3,50%	-0,03%	-0,13%	-0,45%
03.10.2012		25	3,25%	0,05%	-0,02%	-0,05%
05.12.2012		25	3,00%	-0,02%	0,00%	0,11%
08.05.2013		25	2,75%	0,02%	-0,07%	0,07%
07.08.2013		25	2,50%	0,03%	-0,02%	0,15%
04.02.2015		25	2,25%	-0,07%	0,01%	-0,03%
06.05.2015		25	2,00%	-0,02%	0,01%	-0,31%
04.05.2016		25	1,75%	-0,02%	0,01%	0,13%
03.08.2016		25	1,50%	-0,01%	0,00%	

*Up to announcement on 07.11.2007, interest rate change with immediate effect; announcement day = day of change
From 05.02.2008 on, interest rate change one day after announcement

Table 91: Results: AUS Interest Rate Changes Trading before Transaction Costs

(Bloomberg L.P., 2017 and Reserve Bank of Australia, 2017a, own graph)

According to Date of Change	Australia									
	IR1 Comdty (Three-month Future)					XM1 Comdty (Ten-year Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
05.01.1999 - 03.03.2017	0,08767%	0,68032%	0,12886	0,1796307	0,000	-0,17466%	1,05401%	-0,16571	-0,3594842	1,000
20.03.2000 - 12.05.2000	-0,62656%	0,92815%	-0,67506	0,8842307	0,248	2,57817%	1,13227%	2,27699	2,2164221	0,777
15.01.2001 - 09.03.2001	2,55107%	0,79332%	0,12886	0,1796307	0,000	2,73006%	0,87941%	3,10442	0,0000000	1,000
20.08.2001 - 12.10.2001	3,93584%	1,00058%	3,93356	0,0000000	0,000	2,07559%	1,15715%	1,79371	0,0000000	0,999
15.04.2002 - 07.06.2002	0,19508%	0,58841%	0,33153	1,3725376	0,037	-0,79264%	1,00320%	-0,79010	-2,5666771	0,964
10.11.2003 - 02.01.2004	-0,13888%	0,42910%	-0,32365	0,6383913	0,311	-1,87583%	1,02761%	-1,82543	-3,5414592	0,686

Table 92: Impact of BOJ Interest Rate Decisions on Euroyen Tibor 3-month Future

(Bloomberg L.P., 2017 and Bank of Japan, 2017, own graph)

Japan						
Cash Rate						
BOJ Statement as of*	Increase (bps)	Decrease (bps)	Level	YE1 Comdty		
				Announcement day	1 day after	between Announcements
28.02.2001		10	0,25%	-0,01%	0,06%	0,14%
18.09.2001		15	0,10%	0,00%	-0,01%	0,09%
14.07.2006	15		0,25%	0,06%	0,00%	0,24%
21.02.2007	25		0,50%	-0,02%	0,00%	0,42%
31.10.2008		20	0,30%	-0,01%	0,00%	-0,04%
19.12.2008		20	0,10%	0,04%	0,04%	0,18%
05.10.2010		10	0 - 0,10%	0,01%	-0,01%	0,18%
29.01.2016		10	-0,10%	0,08%	0,07%	

*Interest rate decisions have an immediate effect, except for those on 28.02.2001 & 18.09.2001 (with effect from one day following the announcement), as well as 29.01.2016 (implemented on 16.02.2016)

Table 93: Results: JPN Interest Rate Decisions Trading before Transaction Costs

(Bloomberg L.P., 2017 and Bank of Japan, 2017, own graph)

According to Date of Announcement	Japan									
	YE1 Comdty (Three-month Future)					JB1 Comdty (Ten-year Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.01.2001 - 03.03.2017	0,01292%	0,19985%	0,06464	-0,3539496	0,998	1,26737%	3,15303%	0,40195	-0,2395477	0,910
01.02.2001 - 28.03.2001	1,35107%	0,24839%	5,43933	0,0000000	0,000	11,24139%	4,20827%	2,67126	0,0000000	0,000
03.07.2006 - 25.08.2006	-0,31988%	0,43944%	-0,72792	-3,9141991	0,847	-2,53800%	3,78107%	-0,67124	-4,8770681	0,817
01.02.2007 - 28.03.2007	-0,42249%	0,14437%	-2,92654	-2,7050871	1,000	2,05185%	2,62448%	0,78181	-0,5974991	0,135
15.10.2008 - 09.12.2008	2,34352%	0,41547%	5,64071	5,7141392	0,000	5,00973%	4,67555%	1,07147	-2,3442139	0,070
05.11.2008 - 30.12.2008	0,65062%	0,41451%	1,56960	0,0000000	0,016	8,78398%	3,92363%	2,23874	0,0000000	0,001

Table 94: Impact of BOJ Interest Rate Changes on Euroyen Tibor 3-month Future

(Bloomberg L.P., 2017 and Bank of Japan, 2017, own graph)

Japan						
Cash Rate						
Date of Change*	Increase (bps)	Decrease (bps)	Level	YE1 Comdty		
				Day of Change	1 day after	between Changes
01.03.2001		10	0,25%	0,06%	0,01%	0,14%
19.09.2001		15	0,10%	-0,01%	0,00%	0,09%
14.07.2006	15		0,25%	0,06%	0,00%	0,24%
21.02.2007	25		0,50%	-0,02%	0,01%	0,42%
31.10.2008		20	0,30%	-0,01%	0,00%	-0,04%
19.12.2008		20	0,10%	0,04%	0,04%	0,18%
05.10.2010		10	0 - 0,10%	0,01%	-0,01%	0,27%
16.02.2016		10	-0,10%	0,02%	0,00%	

Table 95: Results: JPN Interest Rate Changes Trading before Transaction Costs

(Bloomberg L.P., 2017 and Bank of Japan, 2017, own graph)

According to Date of Change	Japan									
	YE1 Comdty (Three-month Future)					JB1 Comdty (Ten-year Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
01.01.2001 - 03.03.2017	0,01292%	0,19985%	0,06464	-0,3539496	0,980	1,26737%	3,15303%	0,40195	-0,2395477	0,843
01.02.2001 - 28.03.2001	1,35107%	0,24839%	5,43933	0,0000000	0,000	11,24139%	4,20827%	2,67126	0,0000000	0,000
03.07.2006 - 25.08.2006	-0,31988%	0,43944%	-0,72792	-3,9141991	0,951	-2,53800%	3,78107%	-0,67124	-4,8770681	0,936
01.02.2007 - 28.03.2007	-0,42249%	0,14437%	-2,92654	-2,7050871	1,000	2,05185%	2,62448%	0,78181	-0,5974991	0,026
15.10.2008 - 09.12.2008	-0,03248%	0,44234%	-0,07343	0,0000000	0,564	15,66944%	4,58749%	3,41569	0,0000000	0,000
05.11.2008 - 30.12.2008	0,65062%	0,41451%	1,56960	0,0000000	0,000	8,78398%	3,92363%	2,23874	0,0000000	0,000

Table 96: Impact of BOE Interest Rate Decisions on Long Gilt Future

(Bloomberg L.P., 2017 and Bank of England, 2017a&b, own graph)

United Kingdom						
Bank Rate						
BOE Statement as of*	Increase (bps)	Decrease (bps)	Level	G 1 Comdty		
				Announcement day	1 day after	between Announcements
10.02.2000	25		6,00%	-0,29%	0,32%	6,17%
08.02.2001		25	5,75%	-0,43%	0,26%	-0,77%
05.04.2001		25	5,50%	-0,01%	0,47%	-1,08%
10.05.2001		25	5,25%	-0,20%	-0,38%	-0,25%
02.08.2001		25	5,00%	-0,30%	0,23%	1,38%
18.09.2001		25	4,75%	-0,18%	-0,17%	0,44%
04.10.2001		25	4,50%	0,01%	0,04%	2,97%
08.11.2001		50	4,00%	-0,17%	0,15%	2,74%
06.02.2003		25	3,75%	0,13%	0,13%	-0,33%
10.07.2003		25	3,50%	0,47%	0,16%	-4,42%
06.11.2003	25		3,75%	-0,51%	-0,07%	1,62%
05.02.2004	25		4,00%	0,03%	0,24%	-0,46%
06.05.2004	25		4,25%	-0,47%	-0,61%	-1,98%
10.06.2004	25		4,50%	0,24%	-0,15%	1,26%
05.08.2004	25		4,75%	0,56%	0,53%	5,04%
04.08.2005		25	4,50%	0,16%	-0,44%	-2,21%
03.08.2006	25		4,75%	-0,60%	0,24%	0,33%
09.11.2006	25		5,00%	0,20%	0,15%	-1,75%
11.01.2007	25		5,25%	-0,31%	-0,34%	-2,17%
10.05.2007	25		5,50%	-0,15%	0,18%	-3,06%
05.07.2007	25		5,75%	-0,18%	-0,23%	6,79%
06.12.2007		25	5,50%	-0,47%	-0,67%	0,04%
07.02.2008		25	5,25%	0,27%	-0,08%	-0,60%
10.04.2008		25	5,00%	0,31%	0,47%	1,63%
08.10.2008		50	4,50%	-0,43%	-0,57%	-1,56%
06.11.2008		150	3,00%	0,67%	0,98%	7,38%
04.12.2008		100	2,00%	-0,26%	0,28%	2,26%
08.01.2009		50	1,50%	-0,57%	0,72%	-4,39%
05.02.2009		50	1,00%	0,75%	1,80%	6,80%
05.03.2009		50	0,50%	0,17%	0,10%	54,65%
04.08.2016		25	0,25%	0,09%	0,12%	

*Interest rate decisions with immediate effect

Table 97: Results: UK Interest Rate Decisions Trading before Transaction Costs

(Bloomberg L.P., 2017 and Bank of England, 2017a&b, own graph)

According to Date of Announcement/Change	United Kingdom				
	G 1 Comdty (Gilt Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
05.01.2000-03.03.2017	2,35278%	6,07638%	0,38720	-0,3491081	0,662
15.09.2008 - 07.11.2008	2,68668%	10,21951%	0,26290	0,0000000	0,111
14.11.2008 - 07.01.2009	47,34066%	8,62209%	5,49063	0,0000000	0,000
19.12.2008 - 11.02.2009	-12,38872%	9,64274%	-1,28477	0,0000000	0,968
14.01.2009 - 09.03.2009	14,84785%	13,90820%	1,06756	0,0000000	0,072
10.02.2009 - 03.04.2009	12,58119%	13,83000%	0,90970	0,0000000	0,103

Table 98: Results: Outperforming 3-month Futures traded according to Interest Rate Decisions/Changes after Transaction Costs

Date of Change (1999 - 03.03.2017)	United States				European Union (Deposit Facility Rate)				Australia			
	ED1 Comdty (Three-month Future)				ER1 Comdty (Three-month Future)				IR1 Comdty (Three-month Future)			
Cost per Trade	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
0,03%	0,56549%	0,68385%	0,82693	-0,0622477	0,27246%	0,40836%	0,66721	0,1092809	0,01103%	0,68032%	0,01621	0,0669838
0,02%	0,59118%	0,68385%	0,86449	-0,0246829	0,29416%	0,40836%	0,72034	0,1624076	0,03658%	0,68032%	0,05376	0,1045360
0,01%	0,61688%	0,68385%	0,90206	0,0128877	0,31586%	0,40836%	0,77347	0,2155404	0,06213%	0,68032%	0,09132	0,1420941

Date of Announcement (1999 - 03.03.2017)	European Union (Deposit Facility Rate)				Australia			
	ER1 Comdty (Three-month Future)				IR1 Comdty (Three-month Future)			
Cost per Trade	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
0,03%	0,27855%	0,40834%	0,68215	0,1242196	0,01876%	0,68032%	0,02758	0,0783476
0,02%	0,30025%	0,40834%	0,73528	0,1773521	0,04431%	0,68032%	0,06513	0,1159030
0,01%	0,32195%	0,40834%	0,78842	0,2304907	0,06986%	0,68032%	0,10269	0,1534642

7.5.5. Unconventional Monetary Policy Announcements

Table 99: FOMC's Unconventional Monetary Policy Announcements - 25.11.2008-01.02.2017 (Federal Reserve, 2017, own graph)

US	Description of Unconventional Monetary Policy Announcement
25.11.2008	Decision to purchase over the upcoming quarters $100 and $500 billion of agency bonds and mortgage backed securities (MBS)
01.12.2008	Announcement of possible purchases of long-term treasuries
16.12.2008	Status quo ante
28.01.2009	Status quo ante
18.03.2009	Decision to increase the purchase of agency MBS and agency debt by $750 and $100 billion respectively & to purchase $300 billion of long-term treasury securities over the next 6 months
10.08.2010	Status quo ante
21.09.2010	Status quo ante
03.11.2010	Decision to purchase additional $600 billion long-term treasuries during the first two quarters of 2011
21.09.2011	Decision to enlargen the maturity of its holdings: Purchase $400 billion of long-term treasuries with maturities of six to thirty years and sale of treasuries with short-term maturities of three years and lower
20.06.2012	Status quo ante
13.09.2012	Decision to increase agency MBS and long-term treasuries purchases by $40 and $85 billion monthly
19.06.2013	Decision to increase agency MBS and long-term treasuries purchases by $40 and $45 billion monthly
31.07.2013	Status quo ante
18.09.2013	Status quo ante
30.10.2013	Status quo ante
18.12.2013	Decision to reduce additional agency MBS and long-term treasuries purchases to $35 and $40 billion per month
29.01.2014	Decision to reduce additional agency MBS and long-term treasuries purchases to $30 and $35 billion per month
19.03.2014	Decision to reduce additional agency MBS and long-term treasuries purchases to $25 and $30 billion per month
30.04.2014	Decision to reduce additional agency MBS and long-term treasuries purchases to $20 and $25 billion per month
18.06.2014	Decision to reduce additional agency MBS and long-term treasuries purchases to $15 and $20 billion per month
30.07.2014	Decision to reduce additional agency MBS and long-term treasuries purchases to $10 and $15 billion per month
17.09.2014	Decision to reduce additional agency MBS and long-term treasuries purchases to $5 and $10 billion per month
29.10.2014	Decision to conclude APP
17.12.2014	Status quo ante
28.01.2015	Status quo ante
18.03.2015	Status quo ante
29.04.2015	Status quo ante
17.06.2015	Status quo ante
29.07.2015	Status quo ante
17.09.2015	Status quo ante
28.10.2015	Status quo ante
16.12.2015	Status quo ante
27.01.2016	Status quo ante
16.03.2016	Status quo ante
27.04.2016	Status quo ante
15.06.2016	Status quo ante
27.07.2016	Status quo ante
21.09.2016	Status quo ante
02.11.2016	Status quo ante
14.12.2016	Status quo ante
01.02.2017	Status quo ante

Table 100: Impact of QE Announcements on behalf of the FOMC on US Long-term Treasury Rates & Credit Risk (Bloomberg L.P., 2017 and Federal Reserve, 2017, own graph)

United States											
Announcement Date	Interest Rate Development						Corporate Credit Index Development			Correlation between Credit Risk and Interest rates	
	on Announcement day (bps)		1 day after (bps)		between Announcements (bps)		on Announcement day (%)	1 day after (%)	between Announcements (%)	between Announcements	
	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate				10-year T-Note Rate	30-year T-Bond Rate
25.11.2008	-21,58	-16,11	-12,94	-9,68	-40,36	-34,36	-5,30	-3,88	-7,86	0,94	0,79
01.12.2008	-18,91	-22,33	-5,85	-3,96	-40,73	-48,19	10,14	-0,25	11,72	-0,77	-0,86
16.12.2008	-25,69	-21,98	-6,43	-8,47	1,47	28,85	-7,55	-8,64	-24,74	0,40	0,47
28.01.2009	13,91	17,97	19,21	18,31	47,92	58,16	-3,27	2,27	19,16	-0,57	-0,50
18.03.2009	-47,36	-29,29	6,93	9,68	-17,77	19,14	-3,44	0,42	-56,90	-0,37	-0,40
10.08.2010	-6,96	-1,21	-7,79	-8,56	-12,63	-14,08	2,61	4,44	-0,47	-0,78	-0,77
21.09.2010	-12,99	-9,12	-1,44	-3,46	-11,6	5,09	7,10	2,64	-8,91	-0,28	-0,27
03.11.2010	-1,64	11,32	-8,12	3,15	-64,81	-72,42	-1,17	-5,61	37,97	-0,40	-0,41
21.09.2011	-22,05	-40,47	11,54	10,25	-31,88	-46,91	13,74	-3,10	-9,51	-0,72	-0,77
20.06.2012	3,75	0,23	-4,1	-4,88	13,79	18,82	-1,18	3,21	-21,30	-0,65	-0,70
13.09.2012	-3,46	0,96	14,3	15,73	42,78	42	-5,44	-3,25	-9,63	-0,36	-0,41
19.06.2013	16,73	7,04	6,17	10,1	42,47	34,06	-0,17	13,60	-7,60	0,41	0,44
31.07.2013	-3,39	-4,68	12,98	11,89	23,67	15,01	-1,51	-0,47	-3,82	0,30	0,26
18.09.2013	-15,9	-8,51	6,41	5,53	-34,34	-21,95	-5,09	0,94	-2,53	0,22	0,12
30.10.2013	3,44	2,85	1,64	-0,26	33,2	25,32	2,86	-0,46	-1,67	0,17	0,14
18.12.2013	5,77	4,06	3,6	0,28	-8,66	-19,24	-3,53	-2,04	-0,91	-0,49	-0,45
29.01.2014	-7,21	-5,72	1,82	1,78	-7,66	-5,98	4,58	-1,17	-8,89	-0,62	-0,60
19.03.2014	10,03	4,31	-0,09	0,61	1,91	-12,7	2,08	11,21	4,01	-0,16	-0,22
30.04.2014	-4,54	-2,74	-3,26	-4,61	-3,9	-4,46	-2,26	-0,07	-8,70	-0,31	-0,33
18.06.2014	-6,79	-4,13	3,62	6,52	-19,22	-21,73	-4,98	-1,27	0,39	-0,42	-0,49
30.07.2014	9,68	8,78	0,09	0,41	13,23	13,56	0,04	6,65	-0,02	-0,07	-0,09
17.09.2014	2,74	0,86	-0,54	-2,14	-29,64	-29,26	-2,42	-2,66	7,16	-0,42	-0,34
29.10.2014	2,14	-1,83	-1,16	-0,32	-23,69	-37,72	1,71	-0,01	17,79	-0,27	-0,30
17.12.2014	7,65	3,69	7,19	9,07	-23,6	-29,07	-8,36	-6,43	-11,87	-0,67	-0,62
28.01.2015	-10,24	-10,91	3,05	2,4	22,76	20,27	2,78	-1,04	-2,65	-0,31	-0,37
18.03.2015	-13,08	-9,22	4,86	1,87	-4,73	10,05	-4,31	1,70	-6,07	0,27	0,10
29.04.2015	3,54	4,92	-0,71	-1,19	30,59	33,76	2,42	1,16	12,41	0,35	0,36
17.06.2015	0,72	5,25	1,8	3,6	-5,94	-7,57	1,46	-2,29	3,09	-0,70	-0,66
29.07.2015	3,6	3,25	-2,7	-5,46	4,41	11,72	-1,09	1,48	9,02	-0,55	-0,53
17.09.2015	-10,37	-7,68	-5,67	-6,98	-25,7	-22,3	-0,60	2,05	1,41	-0,45	-0,46
28.10.2015	6,39	1,96	7,16	8,01	22,88	12,64	-1,21	1,41	14,05	-0,33	-0,29
16.12.2015	3,02	1,83	-7,26	-7,64	-27,16	-20,12	-0,12	5,53	16,26	-0,61	-0,59
27.01.2016	0,51	1,66	-2,09	-1,59	-2,43	-5,34	0,91	-1,87	-14,41	-0,60	-0,59
16.03.2016	-6,18	-2,05	-1,23	-2,51	-4,28	2,29	-3,71	-2,78	-16,19	-0,36	-0,48
27.04.2016	-7,63	-5,31	-2,65	-2,12	-31,41	-33,06	-0,96	3,20	12,75	-0,35	-0,44
15.06.2016	-4,1	-1,68	0,68	-1,02	-5,19	-14,03	1,13	-2,37	-11,51	-0,69	-0,60
27.07.2016	-6,35	-7,2	0,68	2,08	12,81	14,86					
21.09.2016	-3,81	-5,78	-3,28	-3,85	13,82	14,58					
02.11.2016	-2,49	-1,02	0,9	3,32	64,39	55,38					
14.12.2016	9,94	4,87	2,6	-1,77	-1,82	-7					
01.02.2017	1,68	1,41	0,38	1,24							

Figure 6: Dates of FOMC's QE Measures, Development of US Long-Term Rates and Futures, as well as US Investment Grade Corporate CDS - 03.01.2008-30.08.2016

(Bloomberg L.P., 2017 and Federal Reserve, 2017, own graph)

Table 101: ECB's Unconventional Monetary Policy Announcements - 22.08.2007-15.12.2006

(European Central Bank, 2017a, own graph)

EU	Description of Unconventional Monetary Policy Announcement
22.08.2007	Decision to realize supplementary longer-term refinancing operation (SLTRO) of 40 billion EUR with a maturity of three months
23.08.2007	Allotment of three months LTRO
28.03.2008	Decision to realize a SLTRO with a maturity of six months, a further SLTRO of three months and no change to regular monthly LTROs
07.05.2009	Decision to realize a LTRO with a maturity of one year, to prolonge one-year LTROs announced on October 15, 2008, and to launch a covered bond purchase programme (CBPP)
04.06.2009	Definition of modalities (60 billion EUR) for the first CBPP announced on May 7, 2009
03.12.2009	Decision to carry out the last six-month LTRO on 31 March 2010
04.03.2010	Decision of gradual phase-out of unconventional monetary policy actions
09.05.2010	Decision to conduct securities market programme (SMP)
03.03.2011	Decision to fully conduct the three-month LTROs alloted to April 27, May 25 and June 29 2011, as fixed rate tender procedure
04.08.2011	Decision to fully conduct a six month SLTRO and those alloted to October 26, November 30 and December 21, 2011 all as fixed rate tender procedures, a SMP on Italy and Spain
07.08.2011	ECB acknowledges SMP on Italy and Spain
06.10.2011	Decision to launch second CBPP (CBPP2), amounting to 40 billion EUR
08.12.2011	Decision to conduct two LTROs of 36 months
21.12.2011	Disclosure of second 36-month LTRO's results
26.07.2012	"Whatever it takes speech": ECB proclaims to do anything necessary to keep the euro
02.08.2012	Decision to launch an outright monetary transactions (OMT) programme
06.09.2012	Modalities of OMT Programme set by the ECB
31.10.2012	Conclusion of CBPP2
06.12.2012	Decision to fully conduct the three-month LTROs alloted to January 30, February 27, March 27, April 24, May 29 and June 26, 2013, as fixed rate tender procedure
21.02.2013	Disclosure of Details on securities purchased under SMP
02.05.2013	Decision to fully conduct the three-month LTROs alloted to July 31, August 28, September 25, October 30, November 27 and December 18, 2013, as well as January 29, February 26, March 26, April 30, May 28 and June 25, 2014, as fixed rate tender procedure
22.11.2013	Decision to cancel early repayments of the three-year LTRO
05.06.2014	Decision to fully conduct the three-month LTROs alloted to end of December 2016 the latest, as fixed tender procedure
03.07.2014	Disclosure of details on targeted LTRO (TLTRO I)
29.07.2014	Publication of legal act related to TLTRO I
18.09.2014	Allotment of 82.6 billion EUR in TLTRO I
02.10.2014	Disclosure of details on new ABSPP and CBPP3
30.10.2014	Appointment of executing asset managers for ABSPP
07.11.2014	Decision to cancel early repayments of the three-year LTRO
22.01.2015	Decision to modify interest rate corresponding to future TLTROs
22.01.2015	Announcement of APP (ABSPP & CBPP3) ; 60 million EUR monthly asset purchases, inclusion of euro-area agency, institutions and government bonds
23.09.2015	Adjustment of ABSPP process; increase in purchases by central banks
09.11.2015	Decision to increase issue share limit of public sector purchase programme (PSPP)
10.03.2016	Announcement of TLTRO II
10.03.2016	Announcement of changes to APP and addition of corporate sector purchase programme (CSPP) to APP; combined purchases (ABSPP & CBPP3) are increased from 60 to 80 billion EUR
21.04.2016	Disclosure of details on CSPP
03.05.2016	Publication of legal act related to TLTRO II
02.06.2016	Disclosure of remaining details on CSPP
08.12.2016	Decision to include cash as collateral for PSPP facilities
08.12.2016	APP parameter adjustment
15.12.2016	Adjustment of ABSPP process; decision to have ABSPP fully implemented by central banks

Table 102: Impact of ECB's QE Announcements on German Long-term Treasury Rates & European Credit Risk (Bloomberg L.P., 2017 and European Central Bank, 2017a, own graph)

	Europe												Western Europe				
Announcement Date	Interest Rate Development						Corporate Credit Index Development			Correlation between Credit Risk and Interest rates			Corporate Credit Index Development			Correlation between Credit Risk and Interest rates	
	on Announcement day (bps)		1 day after (bps)		between Announcements (bps)		on Announcement day (%)	1 day after (%)	between Announcements (%)	between Announcements			on Announcement day (%)	1 day after (%)	between Announcements (%)	between Announcements	
	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate				10-year T-Note Rate	30-year T-Bond Rate					10-year T-Note Rate	30-year T-Bond Rate
22.08.2007	6,50	2,50					-6,56										
23.08.2007	-2,70	-1,70	-0,60	-0,50	-37,10	11,20	-7,18	1,37	151,82	-0,52	-0,39						
28.03.2008	1,40	-3,20	-3,90	-3,30	-68,40	-59,60	1,93	5,64	15,18	-0,41	-0,27						
07.05.2009	14,00	15,00	6,70	6,30	33,30	30,90	-6,33	0,95	-17,01	-0,53	-0,54						
04.06.2009	6,50	4,90	8,40	2,40	-41,20	-40,30	-0,93	-5,19	-22,82	-0,49	-0,41						
03.12.2009	1,60	1,80	6,10	3,40	-2,30	-0,90	-1,55	-2,42	-6,03	-0,43	-0,44						
04.03.2010	-1,50	-0,80	3,30	2,30	-34,10	-39,00	2,53	-3,70	79,66	-0,45	-0,43						
09.05.2010	15,80	19,70	-1,80	3,60	40,00	9,40	-27,81	-0,65	-30,02	-0,50	-0,50						
03.03.2011	12,90	10,10	-5,30	-4,30	-79,40	-47,00	-0,18	0,60	27,74	-0,71	-0,72						
04.08.2011	-10,30	-7,80	4,60	1,80	-5,70	-6,00	3,59	3,43	7,14								
07.08.2011	-8,40	-4,30	10,30	8,40	-50,70	-46,80	2,87	1,13	45,63	-0,56	-0,56						
06.10.2011	10,30	10,60	6,00	3,30	26,50	0,10	-3,89	-0,78	-15,67	-0,61	-0,64						
08.12.2011	-8,80	-2,90	13,30	8,20	-14,90	-15,30	4,65	0,07	7,77	-0,75	-0,82		9,13	-0,41	8,38	-0,58	-0,53
21.12.2011	-2,10	0,40	1,00	-0,10	-69,30	-29,30	-1,27	-2,46	-0,41	-0,54	-0,48		2,21	0,00	-22,38	-0,32	-0,29
26.07.2012	5,90	2,90	7,70	6,50	10,60	4,60	-5,33	-3,99	-13,02	-0,75	-0,73		-3,38	-4,24	-8,36	-0,59	-0,56
02.08.2012	-14,10	-14,60	19,70	17,40	11,10	3,30	6,89	-9,94	-10,19	-0,82	-0,81		1,75	-3,05	-15,73	-0,57	-0,60
06.09.2012	8,00	10,30	-4,00	-1,40	-0,10	9,10	-5,82	-4,41	-8,02	-0,69	-0,71		-3,69	-10,05	-50,69	-0,29	-0,29
31.10.2012	-1,60	-3,70	-0,70	-2,10	-13,00	-9,80	0,23	-1,44	-7,78	-0,59	-0,45		0,93	0,93	-3,74	-0,61	-0,51
06.12.2012	-5,20	-2,50	-0,10	2,20	30,60	21,40	-1,49	1,23	-6,85	-0,58	-0,57		1,94	4,76	-3,88	-0,50	-0,42
21.02.2013	-8,10	-5,80	-0,50	0,20	-44,60	-36,30	3,89	-1,33	-9,30	-0,73	-0,55		2,02	-0,99	-4,55	-0,43	-0,33
02.05.2013	-4,30	-3,20	7,50	9,90	53,30	59,70	-4,74	-4,22	-17,51	0,17	0,04		-1,59	0,00	-26,98	-0,04	-0,06
22.11.2013	0,50	-2,30	-2,40	-2,20	-30,80	-36,20	-3,60	-2,15	-22,02	-0,24	-0,32		0,00	0,00	-47,83	-0,02	0,00
05.06.2014	-2,80	-1,30	-5,20	-0,80	-14,60	-9,20	-5,51	-5,00	-9,09	0,23	-0,01		0,00	-12,50	-13,89	0,07	-0,13
03.07.2014	0,20	1,20	-2,40	-2,20	-13,90	-18,30	-4,76	1,47	4,55	-0,59	-0,58		0,00	0,00	12,90	0,21	0,06
29.07.2014	-2,80	-4,20	5,00	6,20	-9,80	-5,30	0,53	0,24	-4,12	-0,37	-0,41		0,00	0,00	-17,14	-0,38	-0,25
18.09.2014	3,10	2,40	-3,80	-3,50	-14,90	-17,50	-2,74	-1,74	6,88	-0,06	-0,28		0,00	0,00	0,00	0,00	0,00
02.10.2014	0,10	-0,70	2,30	0,50	-0,30	-1,90	3,04	-7,77	7,38	-0,55	-0,42		0,00	0,00	13,79	-0,03	-0,09
30.10.2014	-5,30	-6,10	-0,40	1,20	-7,00	-3,60	0,40	-4,49	-5,50	-0,36	-0,41		0,00	0,00	0,00	0,00	0,00
07.11.2014	-1,10	-1,70	1,70	0,40	-30,40	-55,40	1,29	-2,66	-11,32	-0,34	-0,45		0,00	0,00	-9,09	0,14	0,15
22.01.2015	-7,70	-6,00	-8,50	-9,10	6,60	10,30	-2,48	-2,27	43,81	-0,38	-0,38		0,00	0,00	-13,33	0,04	0,06
22.01.2015	-7,70	-6,00	-8,50	-8,50	6,60	10,30	-2,48	-2,27	43,81	-0,38	-0,38		0,00	0,00	-13,33	0,04	0,06
23.09.2015	0,70	-0,10	0,60	-0,40	10,30	21,20	-1,61	7,40	-12,82	-0,28	-0,33		0,00	0,00	0,00	0,00	0,00
09.11.2015	-3,20	2,00	-4,00	-3,60	-45,30	-52,30	2,18	-0,22	28,45	-0,26	-0,39		0,00	0,00	0,00	0,00	0,00
10.03.2016	6,60	5,90	-3,50	-4,90	-8,70	-16,80	-8,04	-18,37	-23,07	0,01	0,03		0,00	0,00	0,00	0,00	0,00
10.03.2016	6,60	5,90	-3,50	-3,50	-8,70	-16,80	-8,04	-18,37	-23,07	0,01	0,03		0,00	0,00	0,00	0,00	0,00
21.04.2016	8,60	9,30	-0,80	2,60	11,40	13,70	-2,56	0,56	4,75	-0,21	-0,29		0,00	0,00	0,00	0,00	0,00
03.05.2016	-6,70	-7,30	0,40	1,00	-13,10	-13,80	3,52	3,30	1,24	-0,05	-0,09		0,00	0,00	0,00	0,00	0,00
02.06.2016	-2,20	-2,90	-4,60	-7,30	21,10	17,90	0,62	1,69					0,00	0,00			
08.12.2016	3,50	10,50	-1,70	4,20	-4,60	4,80											
08.12.2016	3,50	10,50	-1,70	-1,70	-4,60	4,80											
15.12.2016	6,40	6,50	-5,10	-8,30													

Figure 7: Dates of ECB's QE Measures, Development of Long-Term German Treasury Rates and Futures, as well as European & Western European Investment Grade Corporate CDS - 02.01.2007-03.03.2017 (Bloomberg L.P., 2017 and European Central Bank, 2017a, own graph)

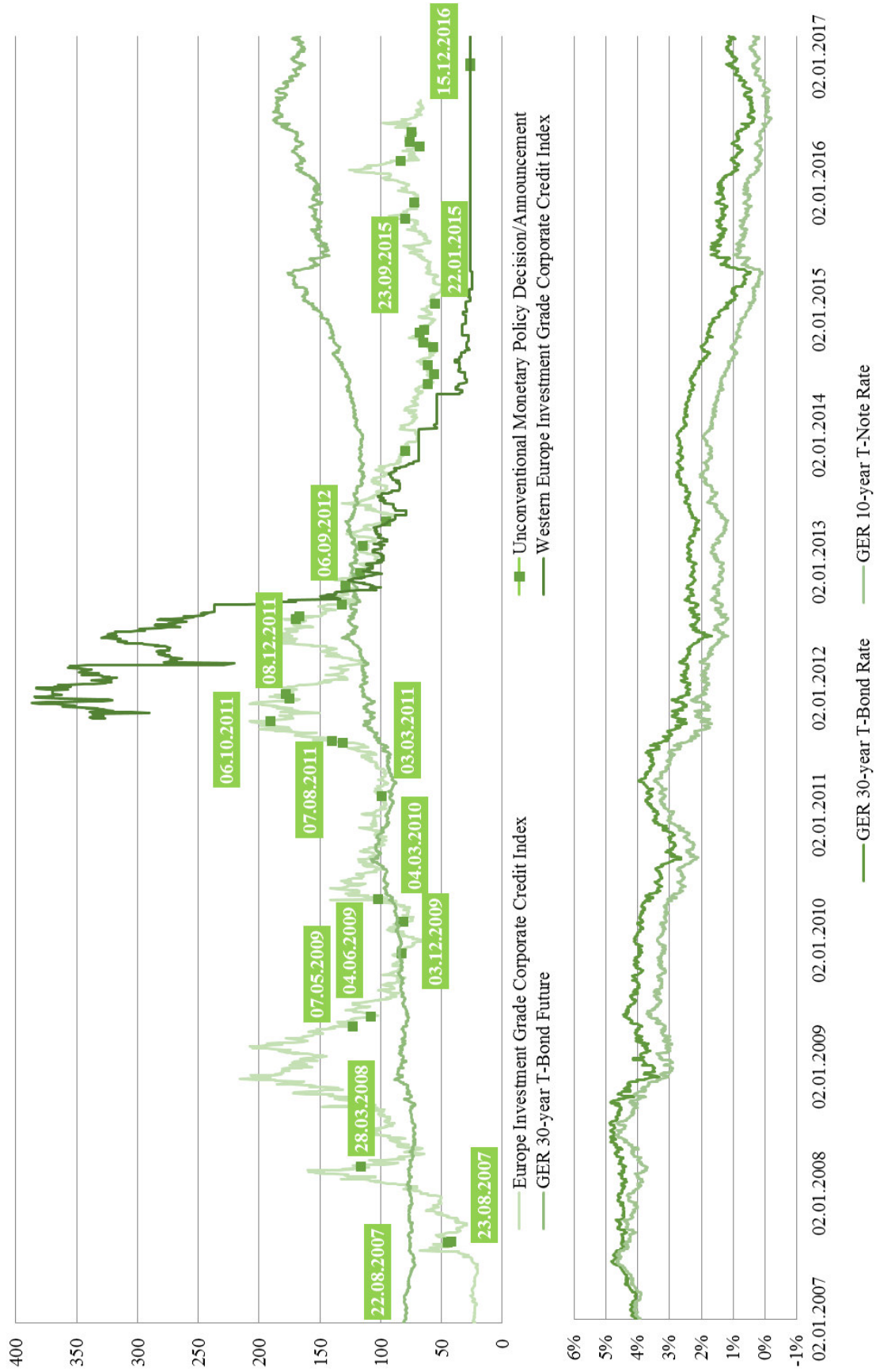


Table 103: BOJ's Unconventional Monetary Policy Announcements - 05.10.2010-18.12.2015 (Bank of Japan, 2017, own graph)

JPN	Description of Unconventional Monetary Policy Announcement
05.10.2010	Decision to launch asset purchase programme (APP) of 35 trillion JPY
28.10.2010	Disclosure of APP details
14.03.2011	Decision to increase purchase of Japanese government bonds (JGB) by 0,5 trillion JPY
04.08.2011	Decision to increase purchase of JGB by 2 trillion JPY
27.10.2011	Decision to increase purchase of JGB by 5 trillion JPY
14.02.2012	Decision to increase purchase of JGB by 10 trillion JPY
27.04.2012	Decision to increase purchase of JGB by 10 trillion JPY
12.07.2012	Decision not to further increase the APP
19.09.2012	Decision to increase purchase of JGB by 5 trillion JPY
30.10.2012	Decision to increase purchase of JGB by 5 trillion JPY
20.12.2012	Decision to increase purchase of JGB by 5 trillion JPY
22.01.2013	Decision to increase purchase of JGB by 2 trillion JPY
04.04.2013	Decision to increase purchase of JGB by 50 trillion JPY annually and to extend maturities
31.10.2014	Decision to increase purchase of JGB by 80 trillion JPY annually and to extend maturities
18.12.2015	Decision to extend maturities of Japanese government bonds from 2016 on

Table 104: Impact of QE Announcements on behalf of the BOJ on Japanese 10-year T-Note Rate & Credit Risk (Bloomberg L.P., 2017 and Bank of Japan, 2017, own graph)

Japan										
	Interest Rate Development				Corporate Credit Index Development				Correlation between Credit Risk and Interest rates	
Announcement Date	on Announcement day (bps)	1 day after (bps)	between Announcements (bps)		on Announcement day (%)	1 day after (%)	between Announcements (%)		between Announcements	
	10-year T-Note Rate	10-year T-Note Rate	10-year T-Note Rate						10-year T-Note Rate	
05.10.2010	-2,90	-7,30	0,80		-2,18	-3,61	-2,35		0,37	
28.10.2010	-4,00	2,40	30,00		-0,94	2,48	-3,55		-0,20	
14.03.2011	-4,20	0,80	-23,70		19,00	26,43	22,16		-0,25	
04.08.2011	0,50	-1,60	-1,90		-0,99	5,84	60,50		-0,36	
27.10.2011	1,30	3,20	-1,70		-8,15	-8,30	-24,70		-0,33	
14.02.2012	-1,60	0,00	-6,50		1,12	1,22	23,68		-0,25	
27.04.2012	-2,00	-0,60	-12,70		1,51	-0,61	-1,61		-0,44	
12.07.2012	-1,60	0,40	2,50		0,56	0,01	8,70		-0,23	
19.09.2012	0,40	-1,90	-4,00		-2,00	11,07	7,86		-0,64	
30.10.2012	-1,40	1,40	-0,30		-2,15	0,00	-24,13		-0,01	
20.12.2012	-0,60	0,00	-3,40		0,30	-0,13	-12,20		-0,72	
22.01.2013	-0,80	0,50	-17,80		0,81	0,78	-19,96		-0,16	
04.04.2013	-11,40	8,80	-9,10		-4,78	-7,66	-36,88		-0,13	
31.10.2014	-1,10	0,00	-16,90		-7,50	-2,28	3,39		-0,38	
18.12.2015	-3,00	1,00			1,29	2,72				

Figure 8: Dates of BOJ's QE Measures, Development of JPN 10-years T-Note Yield & Future, as well as Japanese Investment Grade Corporate CDS - 01.07.2010-31.12.2015

(Bloomberg L.P., 2017 and Bank of Japan, 2017, own graph)

Table 105: BOE's Unconventional Monetary Policy Announcements - 19.01.2009-04.08.2016

(Bank of England, 2017a, own graph)

UK	Description of Unconventional Monetary Policy Announcement
19.01.2009	Announcement of asset purchase facility (APF) set up
29.01.2009	Outline of authorization and operation of BOE in APF on behalf of the chancellor
05.03.2009	Decision to purchase £75 billion of gilts
07.05.2009	Decision to extend the purchase of gilts up to £125 billion
06.08.2009	Decision to extend the purchase of gilts up to £175 billion
05.11.2009	Decision to extend the purchase of gilts up to £200 billion
04.02.2010	Decision to maintain the level of £200 billion gilt purchases
06.10.2011	Decision to extend the purchase of gilts up to £275 billion
09.02.2012	Decision to extend the purchase of gilts up to £325 billion
05.07.2012	Decision to extend the purchase of gilts up to £375 billion
04.08.2016	Decision to extend the purchase of gilts by £60 billion gilts to £435 billion

Table 106: Impact of QE Announcements on behalf of the BOE on UK Long-Term Treasury Rates

(Bloomberg L.P., 2017 and Bank of England, 2017a, own graph)

United Kingdom						
Announcement Date	Interest Rate Development					
	on Announcement day (bps)		1 day after (bps)		between Announcements (bps)	
	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate
19.01.2009	13,20	14,50	8,60	9,80	34,70	27,20
29.01.2009	4,30	0,60	1,70	-2,10	-0,10	9,20
05.03.2009	-28,50	-25,40	-29,40	-30,50	-3,80	-10,40
07.05.2009	7,30	2,30	5,10	3,60	22,20	11,10
06.08.2009	-9,50	-14,80	6,50	-5,00	-3,50	-20,20
05.11.2009	6,20	2,20	3,10	1,70	12,30	8,20
04.02.2010	-1,80	0,50	-1,40	-0,70	-155,90	-108,40
06.10.2011	3,80	7,30	7,60	-3,30	-16,50	-4,70
09.02.2012	3,40	-1,40	-11,30	11,50	-46,80	-17,70
05.07.2012	-6,80	-2,60	-6,20	-0,60	-92,10	-144,80
04.08.2016	-15,90	-1,50	2,90	-13,60		

Figure 9: Dates of BOE's QE Measures, Development of UK Long-Term Treasury Yields & Long Gilt Future - 01.01.2009-03.03.2017 (Bloomberg L.P., 2017 and Bank of England, 2017a, own graph)

Table 107: Correlations between Corporate CDS Spreads and Government Bond Yields

(Bloomberg L.P., 2017, own graph)

	Investment Grade Corporate Credit Index			
Treasury Rate	US	Europe	Western Europe	Japan
10-years	-0,406	-0,418	-0,197	-0,184
30-years	-0,409	-0,380	-0,173	

Table 108: Impact of QE announcements on behalf of the FOMC on German Long-Term Treasury Rates

(Bloomberg L.P., 2017 and Federal Reserve, 2017, own graph)

Germany							
Announcement Date (FOMC)	Interest Rate Development						Correlation between US and German Interest Rates
	on Announcement day (bps)		1 day after (bps)		between Announcements (bps)		between Announcements
	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate	30-year T-Bond Rate	10-year T-Note Rate
25.11.2008	-7,6	-11,8	-6,6	-12,2	-16,8	-30,8	0,98
01.12.2008	-9,4	-7,7	-11,6	-16,8	-6,1	7,1	-0,18
16.12.2008	-6,2	-6,9	-14,8	-12,1	6,3	23,8	0,35
28.01.2009	-2,7	-7,6	2,6	-13,7	-6,9	3,8	0,55
18.03.2009	3	-2,2	-17,6	-11,5	-66,6	-83,2	0,58
10.08.2010	1,2	2,9	-10,9	-9	-5,8	-15,9	0,75
21.09.2010	-1,4	-2,8	-10,4	-8,4	0,3	-16,8	0,56
03.11.2010	-5,2	-5,8	-2,2	6,2	-67,9	-27,8	0,57
21.09.2011	-1,9	-2,8	-9,8	-13,7	-26	-40,5	0,66
20.06.2012	8,4	6,1	-8,1	-9	8,6	24,3	0,73
13.09.2012	-6,3	-6,8	15,2	14,1	-4,7	-4,3	0,66
19.06.2013	-1,2	-1,2	10,7	6,6	9,8	6,1	0,56
31.07.2013	0,2	-1,2	-0,3	-0,9	29,5	24	0,62
18.09.2013	3,7	3,4	-7,9	-1,2	-22,2	-8,6	0,45
30.10.2013	-5,3	-4	-1,4	-0,7	8,6	4	0,70
18.12.2013	2	-0,3	2,4	3,1	-15	-11,2	0,74
29.01.2014	6,5	-2,4	-2,7	-1,3	-11	-8,4	0,70
19.03.2014	3,2	2,6	4,7	1,9	-6,8	-9,5	0,64
30.04.2014	-3	-2,3	0	0	-9,9	-3,7	0,69
18.06.2014	-2,5	-3,4	-5,4	-3,6	-28	-33,5	0,48
30.07.2014	5	6,2	-1,5	-0,5	-5,9	0,2	0,74
17.09.2014	-1,1	-1,3	3,1	2,4	-18,4	-23,1	0,67
29.10.2014	2,1	2,4	-5,3	-6,1	-28,1	-37,7	0,54
17.12.2014	-0,4	0,6	2,5	4,4	-21,3	-33,3	0,32
28.01.2015	-3	-4,1	0,6	0,8	-10,1	-35,2	0,50
18.03.2015	-8,5	-7,1	-1	-2,3	-11,9	-8	0,28
29.04.2015	12,2	15,1	8,1	7,4	63,5	86	0,61
17.06.2015	1	1,4	0	-1,1	-10,9	-12,3	0,60
29.07.2015	2,8	5,3	-6,7	-8	8,5	14,3	0,63
17.09.2015	0,7	-0,7	-11,8	-13,5	-33,1	-33,1	0,64
28.10.2015	-0,5	-0,7	9,2	8,4	19,8	22	0,72
16.12.2015	3,7	3,7	-7,9	-8,3	-19,5	-21,5	0,63
27.01.2016	-0,3	-1	-3,9	-5	-13	-13,4	0,62
16.03.2016	-0,5	-0,9	-8,1	-10,8	-1,7	-4	0,56
27.04.2016	-1,3	2,5	-2,9	-4,1	-30,3	-46,8	0,67
15.06.2016	-0,6	-1,2	-1,4	-4,3	-2,3	-9	0,82
27.07.2016	-5,2	-6,5	-1,1	-2,7	0,9	10,7	0,78
21.09.2016	2	1,6	-9,8	-11,8	19,7	23,3	0,51
02.11.2016	-4,8	-5	2,7	2,3	18,1	34,8	0,47
14.12.2016	-5,9	-8,4	6,4	6,5	7,6	0,2	0,63
01.02.2017	3,2	5,7	-4,1	-4,1			0,84

7.5.6. US Macroeconomic Announcements

Table 109: Results: US Macroeconomic Announcements Trading - In-Sample (Bloomberg L.P., 2017, own graph)

01.02.1999 - 30.12.2011	Start date	**Thirty-days Future**			**Three-months Future**			**Two-years Future**			**Five-years Future**			**Ten-years Future**			**Thirty-years Future**		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	01.02.1999	0,33392%	0,270	0,37395%	0,39355%	0,312	0,80062%	0,63770%	0,108	1,60136%	0,94563%	0,122	3,44463%	0,80366%	0,066	4,57727%	-0,97971%	0,618	4,96878%
CPI	01.02.1999	0,15804%	0,034	0,37395%	0,13428%	0,023	0,80062%	0,79226%	0,024	1,60136%	1,39003%	0,023	3,44463%	2,13493%	0,017	4,57727%	2,42033%	0,047	4,96878%
PPI	09.11.2009	-0,02034%	0,050	0,37395%	-0,31778%	0,001	0,80062%	0,03637%	0,210	1,60136%	-1,78058%	0,017	3,44463%	-4,10089%	0,042	4,57727%	-7,92565%	0,125	4,96878%
GDP Advance	26.03.1999	0,24091%	0,147	0,37395%	0,58050%	0,016	0,80062%	0,96454%	0,065	1,60136%	2,49226%	0,033	3,44463%	4,22612%	0,025	4,57727%	4,46596%	0,044	4,96878%
Durable goods orders	01.02.1999	-0,07616%	0,591	0,37395%	-0,10679%	0,723	0,80062%	0,20862%	0,370	1,60136%	0,18865%	0,393	3,44463%	-0,21539%	0,375	4,57727%	-0,03260%	0,335	4,96878%
Initial jobless claims	01.02.1999	-0,00373%	0,087	0,37395%	0,25893%	0,325	0,80062%	0,23266%	0,157	1,60136%	0,34142%	0,145	3,44463%	0,47078%	0,193	4,57727%	1,66044%	0,156	4,96878%
All Announcements	01.02.1999	-0,01440%		0,37395%	-0,06657%		0,80062%	-0,23311%		1,60136%	-0,56688%		3,44463%	-0,70759%		4,57727%	-0,85393%		4,96878%
Annualized Volatility																			
Employment	01.02.1999	0,33354%		0,33337%	0,79956%		0,79836%	1,78472%		1,78236%	4,36623%		4,36127%	6,57253%		6,56628%	10,32329%		10,31794%
CPI	01.02.1999	0,33406%		0,33337%	0,79990%		0,79836%	1,78448%		1,78236%	4,36574%		4,36127%	6,57123%		6,56628%	10,32179%		10,31794%
PPI	09.11.2009	0,05542%		0,05479%	0,36740%		0,36727%	1,02250%		1,01798%	3,77492%		3,76014%	6,25290%		6,23606%	11,68986%		11,67018%
GDP Advance	26.03.1999	0,33563%		0,33511%	0,80259%		0,80180%	1,78829%		1,78626%	4,37105%		4,36791%	6,58055%		6,57877%	10,33518%		10,33338%
Durable goods orders	01.02.1999	0,33417%		0,33337%	0,79992%		0,79836%	1,78513%		1,78236%	4,36666%		4,36127%	6,57281%		6,56628%	10,32331%		10,31794%
Initial jobless claims	01.02.1999	0,33421%		0,33337%	0,79978%		0,79836%	1,78512%		1,78236%	4,36662%		4,36127%	6,57269%		6,56628%	10,32250%		10,31794%
All Announcements	01.02.1999	0,02599%		0,33337%	0,16952%		0,79836%	0,43617%		1,78236%	1,09848%		4,36127%	1,63249%		6,56628%	2,69861%		10,31794%
Annualized Sharpe Ratio																			
Employment	01.02.1999	1,00112		1,12170	0,49221		1,00284	0,35731		0,89845	0,21658		0,78982	0,12228		0,69709	-0,09490		0,48157
CPI	01.02.1999	0,47309		1,12170	0,16787		1,00284	0,44397		0,89845	0,31840		0,78982	0,32489		0,69709	0,23449		0,48157
PPI	09.11.2009	-0,36703		6,82562	-0,86494		2,17993	0,03557		1,57307	-0,47169		0,91609	-0,65584		0,73400	-0,67799		0,42577
GDP Advance	26.03.1999	0,71777		1,11589	0,72328		0,99854	0,53936		0,89649	0,57017		0,78862	0,64221		0,69576	0,43211		0,48085
Durable goods orders	01.02.1999	-0,22790		1,12170	-0,13350		1,00284	0,11687		0,89845	0,04320		0,78982	-0,03277		0,69709	-0,00316		0,48157
Initial jobless claims	01.02.1999	-0,01116		1,12170	0,32375		1,00284	0,13033		0,89845	0,07819		0,78982	0,07163		0,69709	0,16086		0,48157
All Announcements	01.02.1999	-0,55400		1,12170	-0,39268		1,00284	-0,53446		0,89845	-0,51606		0,78982	-0,43345		0,69709	-0,31643		0,48157
Excess Sharpe Ratio																			
Employment	01.02.1999	-0,12058			-0,51063			-0,54114			-0,57324			-0,57481			-0,57647		
CPI	01.02.1999	-0,64862			-0,83497			-0,45448			-0,47143			-0,37220			-0,24708		
PPI	09.11.2009	-7,19265			-3,04486			-1,53751			-1,38778			-1,38984			-1,10376		
GDP Advance	26.03.1999	-0,39812			-0,27525			-0,35712			-0,21845			-0,05355			-0,04873		
Durable goods orders	01.02.1999	-1,34960			-1,13633			-0,78158			-0,74662			-0,72986			-0,48473		
Initial jobless claims	01.02.1999	-1,13287			-0,67909			-0,76812			-0,71163			-0,62546			-0,32071		
All Announcements	01.02.1999	-1,67570			-1,39552			-1,43291			-1,30588			-1,13053			-0,79800		

Table 110: Results: US Macroeconomic Announcements Trading - Out-of-Sample (Bloomberg L.P., 2017, own graph)

02.01.2012 - 03.03.2017	Start date	**Thirty-days Future**			**Three-months Future**			**Two-years Future**			**Five-years Future**			**Ten-years Future**			**Thirty-years Future**		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	02.01.2012	0,04130%	0,000	0,02883%	-0,02447%	0,870	0,13745%	0,14993%	0,324	0,26414%	0,89324%	0,677	0,65522%	2,30695%	0,787	1,20866%	5,65728%	0,737	1,82053%
CPI	02.01.2012	0,07320%	0,112	0,02883%	0,09323%	0,668	0,13745%	0,37218%	0,808	0,26414%	1,52865%	0,770	0,65522%	2,79910%	0,862	1,20866%	6,54629%	0,851	1,82053%
PPI	02.01.2012	-0,01766%	0,472	0,02883%	-0,00584%	0,439	0,13745%	-0,06419%	0,560	0,26414%	0,63043%	0,672	0,65522%	1,75711%	0,636	1,20866%	5,48554%	0,608	1,82053%
GDP Advance	02.01.2012	0,00063%	0,000	0,02883%	-0,02874%	0,788	0,13745%	0,04922%	0,150	0,26414%	-0,79238%	0,509	0,65522%	1,74384%	0,633	1,20866%	-3,02007%	0,575	1,82053%
Durable goods orders	02.01.2012	0,01198%	1,000	0,02883%	0,19426%	0,991	0,13745%	0,60313%	1,000	0,26414%	2,71656%	0,979	0,65522%	-5,06027%	0,863	1,20866%	6,08178%	0,749	1,82053%
Initial jobless claims	02.01.2012	-0,03287%	0,982	0,02883%	0,02103%	0,224	0,13745%	0,12253%	0,224	0,26414%	0,75331%	0,243	0,65522%	1,55904%	0,377	1,20866%	3,55068%	0,473	1,82053%
All Announcements	02.01.2012	0,00043%		0,02883%	0,02812%		0,13745%	0,12479%		0,26414%	0,54273%		0,65522%	0,92189%		1,20866%	1,78116%		1,82053%
Annualized Volatility																			
Employment	02.01.2012	0,09098%		0,09100%	0,21967%		0,21950%	0,73941%		0,73928%	2,74793%		2,74820%	4,59090%		4,59263%	9,38493%		9,39133%
CPI	02.01.2012	0,09090%		0,09100%	0,21960%		0,21950%	0,73910%		0,73928%	2,74680%		2,74820%	4,58981%		4,59263%	9,38267%		9,39133%
PPI	02.01.2012	0,09101%		0,09100%	0,21967%		0,21950%	0,73946%		0,73928%	2,74823%		2,74820%	4,59189%		4,59263%	9,38533%		9,39133%
GDP Advance	02.01.2012	0,09102%		0,09100%	0,21967%		0,21950%	0,73947%		0,73928%	2,74813%		2,74820%	4,59191%		4,59263%	9,39094%		9,39133%
Durable goods orders	02.01.2012	0,09102%		0,09100%	0,21933%		0,21950%	0,73849%		0,73928%	2,74321%		2,74820%	4,58216%		4,59263%	9,38389%		9,39133%
Initial jobless claims	02.01.2012	0,09100%		0,09100%	0,21967%		0,21950%	0,73943%		0,73928%	2,74810%		2,74820%	4,59219%		4,59263%	9,38913%		9,39133%
All Announcements	02.01.2012	0,01079%		0,09100%	0,06016%		0,21950%	0,13515%		0,73928%	0,54278%		2,74820%	0,97818%		4,59263%	2,20352%		9,39133%
Annualized Sharpe Ratio																			
Employment	02.01.2012	0,45394		0,31685	-0,11140		0,62619	0,20278		0,35730	0,32506		0,23842	0,50251		0,26317	0,60281		0,19385
CPI	02.01.2012	0,80521		0,31685	0,42455		0,62619	0,50357		0,35730	0,55652		0,23842	0,60985		0,26317	0,69770		0,19385
PPI	02.01.2012	-0,19399		0,31685	-0,02658		0,62619	-0,08681		0,35730	0,22939		0,23842	0,38265		0,26317	0,58448		0,19385
GDP Advance	02.01.2012	0,00693		0,31685	-0,13082		0,62619	0,06656		0,35730	-0,28833		0,23842	0,37976		0,26317	-0,32159		0,19385
Durable goods orders	02.01.2012	0,13163		0,31685	0,88567		0,62619	0,81671		0,35730	0,99029		0,23842	-1,10434		0,26317	0,64811		0,19385
Initial jobless claims	02.01.2012	-0,36119		0,31685	0,09575		0,62619	0,16571		0,35730	0,27412		0,23842	0,33950		0,26317	0,37817		0,19385
All Announcements	02.01.2012	0,03982		0,31685	0,46741		0,62619	0,92333		0,35730	0,99991		0,23842	0,94246		0,26317	0,80833		0,19385
Excess Sharpe Ratio																			
Employment	02.01.2012	0,13709			-0,73759			-0,15452			0,08664			0,23933			0,40895		
CPI	02.01.2012	0,48836			-0,20164			0,14627			0,31810			0,34668			0,50385		
PPI	02.01.2012	-0,51083			-0,65277			-0,44410			-0,00902			0,11948			0,39063		
GDP Advance	02.01.2012	-0,30992			-0,75701			-0,29074			-0,52675			0,11659			-0,51545		
Durable goods orders	02.01.2012	-0,18522			0,25948			0,45941			0,75187			-1,36751			0,45426		
Initial jobless claims	02.01.2012	-0,67804			-0,53045			-0,19158			0,03570			0,07632			0,18432		
All Announcements	02.01.2012	-0,27703			-0,15878			0,56603			0,76149			0,67929			0,61447		

Table 111: Results: US Macroeconomic Announcements Trading - 10.02.2000-27.12.2001 (Bloomberg L.P., 2017, own graph)

10.02.2000 - 27.12.2001	Start date	Thirty-days Future			Three-months Future			Two-years Future			Five-years Future			Ten-years Future			Thirty-years Future		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	10.02.2000	0,63172%	0,911	0,72036%	0,93771%	0,969	2,39108%	1,66178%	0,776	3,57555%	2,97516%	0,717	5,58486%	4,43925%	0,673	7,48754%	2,48456%	0,516	6,00337%
CPI	10.02.2000	0,48006%	0,846	0,72036%	1,30336%	0,106	2,39108%	1,99247%	0,125	3,57555%	2,17599%	0,186	5,58486%	0,88626%	0,176	7,48754%	-5,06102%	0,231	6,00337%
PPI																			
GDP Advance	10.02.2000	0,48760%	0,031	0,72036%	1,60421%	0,000	2,39108%	2,76684%	0,030	3,57555%	4,03210%	0,100	5,58486%	9,65193%	0,187	7,48754%	3,71868%	0,466	6,00337%
Durable goods orders	10.02.2000	0,05433%	0,016	0,72036%	0,06658%	0,024	2,39108%	0,64459%	0,284	3,57555%	1,90915%	0,349	5,58486%	-3,42470%	0,474	7,48754%	9,04593%	0,643	6,00337%
Initial jobless claims	10.02.2000	-0,07619%	0,093	0,72036%	0,89330%	0,009	2,39108%	2,05496%	0,047	3,57555%	4,15253%	0,053	5,58486%	6,77578%	0,085	7,48754%	9,74231%	0,248	6,00337%
Annualized Volatility																			
Employment	10.02.2000	0,45835%		0,45783%	0,80643%		0,79464%	1,93957%		1,92956%	4,14656%		4,13638%	6,29563%		6,28514%	9,23936%		9,23335%
CPI	10.02.2000	0,45913%		0,45783%	0,80452%		0,79464%	1,93842%		1,92956%	4,14837%		4,13638%	6,30103%		6,28514%	9,23660%		9,23335%
PPI																			
GDP Advance	10.02.2000	0,45910%		0,45783%	0,80241%		0,79464%	1,93475%		1,92956%	4,14290%		4,13638%	6,27478%		6,28514%	9,23629%		9,23335%
Durable goods orders	10.02.2000	0,46009%		0,45783%	0,80861%		0,79464%	1,94198%		1,92956%	4,14902%		4,13638%	6,29770%		6,28514%	9,22452%		9,23335%
Initial jobless claims	10.02.2000	0,46009%		0,45783%	0,80663%		0,79464%	1,93809%		1,92956%	4,14268%		4,13638%	6,28803%		6,28514%	9,22206%		9,23335%
Annualized Sharpe Ratio																			
Employment	10.02.2000	1,37824		1,57341	1,16280		3,00900	0,85678		1,85304	0,71750		1,35018	0,70513		1,19131	0,26891		0,65018
CPI	10.02.2000	1,04558		1,57341	1,62004		3,00900	1,02788		1,85304	0,52454		1,35018	0,14065		1,19131	-0,54793		0,65018
PPI																			
GDP Advance	10.02.2000	1,06207		1,57341	1,99924		3,00900	1,43007		1,85304	0,97325		1,35018	1,53821		1,19131	0,40262		0,65018
Durable goods orders	10.02.2000	0,11808		1,57341	0,08234		3,00900	0,33192		1,85304	0,46014		1,35018	-0,54380		1,19131	0,98064		0,65018
Initial jobless claims	10.02.2000	-0,16559		1,57341	1,10745		3,00900	1,06031		1,85304	1,00238		1,35018	1,07757		1,19131	1,05641		0,65018
Excess Sharpe Ratio																			
Employment	10.02.2000	-0,19517			-1,84620			-0,99625			-0,63268			-0,48618			-0,38127		
CPI	10.02.2000	-0,52783			-1,38896			-0,82515			-0,82564			-1,05066			-1,19812		
PPI																			
GDP Advance	10.02.2000	-0,51135			-1,00976			-0,42296			-0,37693			0,34690			-0,24757		
Durable goods orders	10.02.2000	-1,45533			-2,92666			-1,52111			-0,89004			-1,73511			0,33046		
Initial jobless claims	10.02.2000	-1,73901			-1,90155			-0,79273			-0,34780			-0,11374			0,40623		

Table 112: Results: US Macroeconomic Announcements Trading - 07.02.2003-03.03.2003 (Bloomberg L.P., 2017, own graph)

07.02.2003 - 03.03.2003	Start date	**Thirty-days Future**			**Three-months Future**			**Two-years Future**			**Five-years Future**			**Ten-years Future**			**Thirty-years Future**		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	07.02.2003	0,52667%	1,000	-0,52395%	-1,19670%	0,000	1,20964%	-4,65863%	0,000	4,87504%	-18,85156%	0,00000%	23,10270%	-26,38683%	0,000	35,54863%	-31,38211%	0,000	44,81141%
CPI	07.02.2003	0,52667%	1,000	-0,52395%	-1,19670%	0,000	1,20964%	-4,65863%	0,000	4,87504%	-18,85156%	0,00000%	23,10270%	-26,38683%	0,000	35,54863%	-31,38211%	0,000	44,81141%
PPI																			
GDP Advance	07.02.2003	-0,52395%	1,000	-0,52395%	1,20964%	0,000	1,20964%	4,87504%	0,000	4,87504%	23,10270%	0,00000%	23,10270%	35,54863%	0,000	35,54863%	44,81141%	0,000	44,81141%
Durable goods orders	07.02.2003	0,52667%	1,000	-0,52395%	-1,19670%	0,000	1,20964%	-4,65863%	0,000	4,87504%	-18,85156%	0,00000%	23,10270%	35,54863%	0,000	35,54863%	-31,38211%	0,000	44,81141%
Initial jobless claims	07.02.2003	0,52667%	1,000	-0,52395%	-1,19670%	0,000	1,20964%	-4,65863%	0,000	4,87504%	-18,85156%	0,00000%	23,10270%	-26,38683%	0,000	35,54863%	-31,38211%	0,000	44,81141%
Annualized Volatility																			
Employment	07.02.2003	0,04972%		0,04972%	0,45007%		0,45007%	1,05338%		1,05338%	3,07308%		3,07308%	4,37489%		4,37489%	7,85940%		7,85940%
CPI	07.02.2003	0,04972%		0,04972%	0,45007%		0,45007%	1,05338%		1,05338%	3,07308%		3,07308%	4,37489%		4,37489%	7,85940%		7,85940%
PPI																			
GDP Advance	07.02.2003	0,04972%		0,04972%	0,45007%		0,45007%	1,05338%		1,05338%	3,07308%		3,07308%	4,37489%		4,37489%	7,85940%		7,85940%
Durable goods orders	07.02.2003	0,04972%		0,04972%	0,45007%		0,45007%	1,05338%		1,05338%	3,07308%		3,07308%	4,37489%		4,37489%	7,85940%		7,85940%
Initial jobless claims	07.02.2003	0,04972%		0,04972%	0,45007%		0,45007%	1,05338%		1,05338%	3,07308%		3,07308%	4,37489%		4,37489%	7,85940%		7,85940%
Annualized Sharpe Ratio																			
Employment	07.02.2003	10,59326		-10,53844	-2,65894		2,68769	-4,42254		4,62798	-6,13443		7,51778	-6,03143		8,12560	-3,99294		5,70163
CPI	07.02.2003	10,59326		-10,53844	-2,65894		2,68769	-4,42254		4,62798	-6,13443		7,51778	-6,03143		8,12560	-3,99294		5,70163
PPI																			
GDP Advance	07.02.2003	-10,53844		-10,53844	2,68769		2,68769	4,62798		4,62798	7,51778		7,51778	8,12560		8,12560	5,70163		5,70163
Durable goods orders	07.02.2003	10,59326		-10,53844	-2,65894		2,68769	-4,42254		4,62798	-6,13443		7,51778	8,12560		8,12560	-3,99294		5,70163
Initial jobless claims	07.02.2003	10,59326		-10,53844	-2,65894		2,68769	-4,42254		4,62798	-6,13443		7,51778	-6,03143		8,12560	-3,99294		5,70163
Excess Sharpe Ratio																			
Employment	07.02.2003	21,13170			-5,34663			-9,05052			-13,65220			-14,15703			-9,69457		
CPI	07.02.2003	21,13170			-5,34663			-9,05052			-13,65220			-14,15703			-9,69457		
PPI																			
GDP Advance	07.02.2003	0,00000			0,00000			0,00000			0,00000			0,00000			0,00000		
Durable goods orders	07.02.2003	21,13170			-5,34663			-9,05052			-13,65220			0,00000			-9,69457		
Initial jobless claims	07.02.2003	21,13170			-5,34663			-9,05052			-13,65220			-14,15703			-9,69457		

Table 113: Results: US Macroeconomic Announcements Trading - 23.05.2003-17.10.2003 (Bloomberg L.P., 2017, own graph)

23.05.2003 - 17.10.2003	Start date	Thirty-days Future			Three-months Future			Two-years Future			Five-years Future			Ten-years Future			Thirty-years Future		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	23.05.2003	0,10831%	0,918	-0,10824%	4,17201%	0,977	-0,66281%	7,63873%	1,000	-0,46594%	26,64433%	1,000	-4,82454%	43,90165%	0,998	-9,92962%	77,46140%	0,998	-21,75630%
CPI	23.05.2003	0,10781%	0,914	-0,10824%	-1,03344%	0,748	-0,66281%	-1,72685%	0,675	-0,46594%	-1,91402%	0,723	-4,82454%	-2,48274%	0,727	-9,92962%	-2,10773%	0,767	-21,75630%
PPI																			
GDP Advance	23.05.2003	0,10831%	0,904	-0,10824%	0,65292%	0,669	-0,66281%	0,42240%	0,561	-0,46594%	4,72720%	0,769	-4,82454%	-9,92962%	0,808	-9,92962%	25,35199%	0,917	-21,75630%
Durable goods orders	23.05.2003	0,01216%	0,552	-0,10824%	0,89846%	0,716	-0,66281%	1,44821%	0,714	-0,46594%	4,76112%	0,758	-4,82454%	########	0,834	-9,92962%	21,17896%	0,817	-21,75630%
Initial jobless claims	23.05.2003	0,03608%	0,056	-0,10824%	1,31721%	0,000	-0,66281%	3,04783%	0,000	-0,46594%	7,92537%	0,000	-4,82454%	8,73551%	0,000	-9,92962%	10,86943%	0,001	-21,75630%
Annualized Volatility																			
Employment	23.05.2003	0,06385%		0,06385%	1,16921%		1,19741%	2,09178%		2,14468%	5,53409%		5,72805%	8,58830%		8,87492%	13,49818%		13,91166%
CPI	23.05.2003	0,06385%		0,06385%	1,19630%		1,19741%	2,14183%		2,14468%	5,73508%		5,72805%	8,89658%		8,87492%	13,98958%		13,91166%
PPI																			
GDP Advance	23.05.2003	0,06385%		0,06385%	1,19741%		1,19741%	2,14468%		2,14468%	5,72805%		5,72805%	8,87492%		8,87492%	13,91166%		13,91166%
Durable goods orders	23.05.2003	0,06421%		0,06385%	1,19703%		1,19741%	2,14329%		2,14468%	5,72837%		5,72805%	8,87152%		8,87492%	13,92984%		13,91166%
Initial jobless claims	23.05.2003	0,06417%		0,06385%	1,19513%		1,19741%	2,13574%		2,14468%	5,71467%		5,72805%	8,88041%		8,87492%	13,97224%		13,91166%
Annualized Sharpe Ratio																			
Employment	23.05.2003	1,69648		-1,69526	3,56823		-0,55353	3,65178		-0,21725	4,81458		-0,84227	5,11180		-1,11884	5,73865		-1,56389
CPI	23.05.2003	1,68845		-1,69526	-0,86387		-0,55353	-0,80625		-0,21725	-0,33374		-0,84227	-0,27907		-1,11884	-0,15066		-1,56389
PPI																			
GDP Advance	23.05.2003	1,69646		-1,69526	0,54528		-0,55353	0,19695		-0,21725	0,82527		-0,84227	-1,11884		-1,11884	1,82236		-1,56389
Durable goods orders	23.05.2003	0,18934		-1,69526	0,75057		-0,55353	0,67570		-0,21725	0,83115		-0,84227	-1,18327		-1,11884	1,52040		-1,56389
Initial jobless claims	23.05.2003	0,56220		-1,69526	1,10214		-0,55353	1,42706		-0,21725	1,38685		-0,84227	0,98368		-1,11884	0,77793		-1,56389
Excess Sharpe Ratio																			
Employment	23.05.2003	3,39174			4,12177			3,86903			5,65685			6,23064			7,30254		
CPI	23.05.2003	3,38371			-0,31034			-0,58900			0,50853			0,83977			1,41323		
PPI																			
GDP Advance	23.05.2003	3,39172			1,09881			0,41420			1,66754			0,00000			3,38625		
Durable goods orders	23.05.2003	1,88461			1,30411			0,89295			1,67341			-0,06443			3,08429		
Initial jobless claims	23.05.2003	2,25747			1,65568			1,64432			2,22911			2,10252			2,34182		

Table 114: Results: US Macroeconomic Announcements Trading - 14.12.2009-03.01.2011 (Bloomberg L.P., 2017, own graph)

14.12.2009 - 03.01.2011	Start date	Thirty-days Future			Three-months Future			Two-years Future			Five-years Future			Ten-years Future			Thirty-years Future		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	14.12.2009	-0,04582%	0,443	0,14198%	0,32528%	0,781	0,49331%	-0,23508%	0,780	1,60243%	-1,20536%	0,971	4,08359%	-4,57877%	0,918	5,13032%	-10,55740%	0,806	6,33646%
CPI	14.12.2009	0,12363%	0,956	0,14198%	0,05026%	0,603	0,49331%	2,62582%	0,665	1,60243%	9,68954%	0,893	4,08359%	14,03446%	0,834	5,13032%	17,49175%	0,831	6,33646%
PPI	14.12.2009	-0,04590%	0,039	0,14198%	-0,78766%	0,042	0,49331%	-0,12590%	0,443	1,60243%	-1,51110%	0,474	4,08359%	-2,65780%	0,544	5,13032%	-5,78860%	0,530	6,33646%
GDP Advance	14.12.2009	0,05497%	0,035	0,14198%	0,10543%	0,193	0,49331%	1,21266%	0,189	1,60243%	6,90725%	0,198	4,08359%	5,13032%	0,237	5,13032%	15,47692%	0,288	6,33646%
Durable goods orders	14.12.2009	-0,02744%	0,377	0,14198%	-0,13387%	0,338	0,49331%	-1,10908%	0,167	1,60243%	-4,10650%	0,107	4,08359%	6,45466%	0,201	5,13032%	-7,94917%	0,277	6,33646%
Initial jobless claims	14.12.2009	0,10983%	0,170	0,14198%	-0,12498%	0,224	0,49331%	1,93061%	0,488	1,60243%	5,26637%	0,261	4,08359%	8,45971%	0,243	5,13032%	12,48287%	0,210	6,33646%
Annualized Volatility																			
Employment	14.12.2009	0,06373%		0,06317%	0,34377%		0,34294%	1,10897%		1,10483%	3,89467%		3,88746%	6,35144%		6,34930%	11,28596%		11,29755%
CPI	14.12.2009	0,06329%		0,06317%	0,34436%		0,34294%	1,09617%		1,10483%	3,84834%		3,88746%	6,30082%		6,34930%	11,25725%		11,29755%
PPI	14.12.2009	0,06373%		0,06317%	0,34071%		0,34294%	1,10901%		1,10483%	3,89433%		3,88746%	6,35569%		6,34930%	11,30072%		11,29755%
GDP Advance	14.12.2009	0,06368%		0,06317%	0,34431%		0,34294%	1,10607%		1,10483%	3,87021%		3,88746%	6,34930%		6,34930%	11,26688%		11,29755%
Durable goods orders	14.12.2009	0,06376%		0,06317%	0,34427%		0,34294%	1,10652%		1,10483%	3,88551%		3,88746%	6,34407%		6,34930%	11,29605%		11,29755%
Initial jobless claims	14.12.2009	0,06339%		0,06317%	0,34427%		0,34294%	1,10190%		1,10483%	3,88006%		3,88746%	6,33531%		6,34930%	11,27948%		11,29755%
Annualized Sharpe Ratio																			
Employment	14.12.2009	-0,71906		2,24743	0,94621		1,43846	-0,21198		1,45039	-0,30949		1,05045	-0,72090		0,80801	-0,93545		0,56087
CPI	14.12.2009	1,95352		2,24743	0,14594		1,43846	2,39545		1,45039	2,51785		1,05045	2,22740		0,80801	1,55382		0,56087
PPI	14.12.2009	-0,72029		2,24743	-2,31184		1,43846	-0,11353		1,45039	-0,38803		1,05045	-0,41818		0,80801	-0,51223		0,56087
GDP Advance	14.12.2009	0,86326		2,24743	0,30620		1,43846	1,09637		1,45039	1,78472		1,05045	0,80801		0,80801	1,37366		0,56087
Durable goods orders	14.12.2009	-0,43032		2,24743	-0,38886		1,43846	-1,00231		1,45039	-1,05687		1,05045	1,01743		0,80801	-0,70371		0,56087
Initial jobless claims	14.12.2009	1,73264		2,24743	-0,36303		1,43846	1,75206		1,45039	1,35729		1,05045	1,33533		0,80801	1,10669		0,56087
Excess Sharpe Ratio																			
Employment	14.12.2009	-2,96650			-0,49226			-1,66238			-1,35994			-1,52892			-1,49632		
CPI	14.12.2009	-0,29391			-1,29252			0,94505			1,46740			1,41939			0,99295		
PPI	14.12.2009	-2,96772			-3,75030			-1,56392			-1,43848			-1,22619			-1,07310		
GDP Advance	14.12.2009	-1,38418			-1,13227			-0,35402			0,73427			0,00000			0,81279		
Durable goods orders	14.12.2009	-2,67775			-1,82732			-2,45271			-2,10733			0,20942			-1,26458		
Initial jobless claims	14.12.2009	-0,51480			-1,80150			0,30167			0,30684			0,52731			0,54582		

Table 115: Results: US Macroeconomic Announcements Trading - 08.06.2011-14.11.2011 (Bloomberg L.P., 2017, own graph)

08.06.2011 - 14.11.2011	Start date	Thirty-days Future			Three-months Future			Two-years Future			Five-years Future			Ten-years Future			Thirty-years Future		
Annualized Performance		FF1 Comdty	p-value (RC)	**w/o announce.**	ED1 Comdty	p-value (RC)	**w/o announce.**	TU1 Comdty	p-value (RC)	**w/o announce.**	FV1 Comdty	p-value (RC)	**w/o announce.**	TY1 Comdty	p-value (RC)	**w/o announce.**	US1 Comdty	p-value (RC)	**w/o announce.**
Employment	08.06.2011	0,02769%	0,184	0,07196%	-0,21235%	0,794	-0,52092%	-0,44444%	0,144	0,89767%	-5,17404%	0,066	7,45639%	-6,59838%	0,076	14,28472%	-14,58685%	0,064	33,13363%
CPI	08.06.2011	0,07196%	0,185	0,07196%	-0,52092%	0,803	-0,52092%	0,89767%	0,168	0,89767%	7,45639%	0,065	7,45639%	14,28472%	0,065	14,28472%	33,13363%	0,069	33,13363%
PPI	08.06.2011	-0,07194%	0,207	0,07196%	0,09857%	0,596	-0,52092%	-2,33284%	0,015	0,89767%	-13,12059%	0,006	7,45639%	-21,69973%	0,009	14,28472%	-29,54667%	0,040	33,13363%
GDP Advance	08.06.2011	0,03887%	0,196	0,07196%	-0,18947%	0,810	-0,52092%	1,02726%	0,179	0,89767%	5,52811%	0,076	7,45639%	14,28472%	0,068	14,28472%	19,95359%	0,075	33,13363%
Durable goods orders	08.06.2011	-0,02772%	0,453	0,07196%	0,21088%	0,766	-0,52092%	0,44065%	0,816	0,89767%	5,29020%	0,768	7,45639%	-2,01701%	0,524	14,28472%	14,34626%	0,268	33,13363%
Initial jobless claims	08.06.2011	-0,09425%	0,872	0,07196%	-0,05617%	0,522	-0,52092%	0,24473%	0,415	0,89767%	4,80735%	0,248	7,45639%	9,00332%	0,195	14,28472%	25,71494%	0,127	33,13363%
Annualized Volatility																			
Employment	08.06.2011	0,06497%		0,06483%	0,43976%		0,43876%	0,76331%		0,76115%	4,00337%		3,98223%	7,39826%		7,35040%	15,43731%		15,33363%
CPI	08.06.2011	0,06483%		0,06483%	0,43876%		0,43876%	0,76115%		0,76115%	3,98223%		3,98223%	7,35040%		7,35040%	15,33363%		15,33363%
PPI	08.06.2011	0,06483%		0,06483%	0,43989%		0,43876%	0,74995%		0,76115%	3,92433%		3,98223%	7,25820%		7,35040%	15,32285%		15,33363%
GDP Advance	08.06.2011	0,06495%		0,06483%	0,43980%		0,43876%	0,76044%		0,76115%	3,99502%		3,98223%	7,35040%		7,35040%	15,40410%		15,33363%
Durable goods orders	08.06.2011	0,06497%		0,06483%	0,43976%		0,43876%	0,76331%		0,76115%	4,00337%		3,98223%	7,40687%		7,35040%	15,43731%		15,33363%
Initial jobless claims	08.06.2011	0,06472%		0,06483%	0,43993%		0,43876%	0,76358%		0,76115%	4,00537%		3,98223%	7,38955%		7,35040%	15,39313%		15,33363%
Annualized Sharpe Ratio																			
Employment	08.06.2011	0,42614		1,10990	-0,48288		-1,18725	-0,58225		1,17937	-1,29242		1,87241	-0,89188		1,94339	-0,94491		2,16085
CPI	08.06.2011	1,10990		1,10990	-1,18725		-1,18725	1,17937		1,17937	1,87241		1,87241	1,94339		1,94339	2,16085		2,16085
PPI	08.06.2011	-1,10958		1,10990	0,22407		-1,18725	-3,11065		1,17937	-3,34339		1,87241	-2,98969		1,94339	-1,92828		2,16085
GDP Advance	08.06.2011	0,59850		1,10990	-0,43080		-1,18725	1,35087		1,17937	1,38375		1,87241	1,94339		1,94339	1,29534		2,16085
Durable goods orders	08.06.2011	-0,42667		1,10990	0,47953		-1,18725	0,57729		1,17937	1,32144		1,87241	-0,27232		1,94339	0,92932		2,16085
Initial jobless claims	08.06.2011	-1,45622		1,10990	-0,12767		-1,18725	0,32050		1,17937	1,20023		1,87241	1,21839		1,94339	1,67055		2,16085
Excess Sharpe Ratio																			
Employment	08.06.2011	-0,68375			0,70438			-1,76163			-3,16483			-2,83528			-3,10576		
CPI	08.06.2011	0,00000			0,00000			0,00000			0,00000			0,00000			0,00000		
PPI	08.06.2011	-2,21948			1,41133			-4,29002			-5,21581			-4,93308			-4,08912		
GDP Advance	08.06.2011	-0,51140			0,75646			0,17150			-0,48866			0,00000			-0,86550		
Durable goods orders	08.06.2011	-1,53657			1,66679			-0,60209			-0,55098			-2,21571			-1,23152		
Initial jobless claims	08.06.2011	-2,56612			1,05958			-0,85887			-0,67219			-0,72501			-0,49030		

Table 116: Results: US Macroeconomic Announcements Trading after Transaction Costs - Out-of-Sample (Bloomberg L.P., 2017, own graph)

Cost per Trade		US Macroeconomic Announcements after Transaction costs (Out-of-Sample)																							
		FF1 Comdty (Thirty-days Future)				ED1 Comdty (Three-months Future)				TU1 Comdty (Two-years Future)				FV1 Comdty (Five-years Future)				TY1 Comdty (Ten-years Future)				US1 Comdty (Thirty-years Future)			
		Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
Employment	0,03%	-0,19935%	0,09098%	-2,19099	-2,50784									0,65055%	2,74793%	0,23674	-0,00167	2,06088%	4,59090%	0,44890	0,18573	5,40318%	9,38493%	0,57573	0,38188
	0,02%	-0,11919%	0,09098%	-1,30997	-1,62681									0,73139%	2,74793%	0,26616	0,02774	2,14285%	4,59090%	0,46676	0,20359	5,48782%	9,38493%	0,58475	0,39090
	0,01%	-0,03897%	0,09098%	-0,42832	-0,74517									0,81229%	2,74793%	0,29560	0,05718	2,22487%	4,59090%	0,48463	0,22145	5,57252%	9,38493%	0,59377	0,39992
CPI	0,03%	-0,08362%	0,09090%	-0,91986	-1,23671					0,21490%	0,73910%	0,29076	-0,06654	1,36956%	2,74680%	0,49860	0,26019	2,63803%	4,58981%	0,57476	0,31158	6,37937%	9,38267%	0,67991	0,48606
	0,02%	-0,03137%	0,09090%	-0,34508	-0,66193					0,26731%	0,73910%	0,36167	0,00437	1,42257%	2,74680%	0,51790	0,27948	2,69170%	4,58981%	0,58645	0,32328	6,43498%	9,38267%	0,68584	0,49199
	0,01%	0,02090%	0,09090%	0,22994	-0,08691					0,31973%	0,73910%	0,43260	0,07530	1,47560%	2,74680%	0,53720	0,29879	2,74539%	4,58981%	0,59815	0,33497	6,49062%	9,38267%	0,69177	0,49792
PPI	0,03%																	1,58629%	4,59189%	0,34545	0,08228	5,30848%	9,38533%	0,56561	0,37176
	0,02%																	1,64320%	4,59189%	0,35785	0,09467	5,36747%	9,38533%	0,57190	0,37805
	0,01%																	1,70014%	4,59189%	0,37025	0,10707	5,42649%	9,38533%	0,57819	0,38434
GDP Advance	0,03%																	1,66979%	4,59191%	0,36364	0,10046				
	0,02%																	1,69447%	4,59191%	0,36901	0,10584				
	0,01%																	1,71916%	4,59191%	0,37439	0,11121				
Durable Goods Orders	0,03%					-0,04116%	0,21933%	-0,18765	-0,81384	0,36676%	0,73849%	0,49664	0,13934	2,47524%	2,74321%	0,90232	0,66390					5,83259%	9,38389%	0,62155	0,42770
	0,02%					0,03726%	0,21933%	0,16988	-0,45631	0,44550%	0,73849%	0,60325	0,24596	2,55563%	2,74321%	0,93162	0,69320					5,91560%	9,38389%	0,63040	0,43655
	0,01%					0,11573%	0,21933%	0,52766	-0,09854	0,52429%	0,73849%	0,70995	0,35265	2,63606%	2,74321%	0,96094	0,72253					5,99866%	9,38389%	0,63925	0,44540
Initial Jobless Claims	0,03%													0,49970%	2,74810%	0,18184	-0,05658	1,30341%	4,59219%	0,28383	0,02066	3,29005%	9,38913%	0,35041	0,15656
	0,02%													0,58418%	2,74810%	0,21257	-0,02584	1,38856%	4,59219%	0,30237	0,03920	3,37687%	9,38913%	0,35966	0,16580
	0,01%													0,66871%	2,74810%	0,24334	0,00492	1,47377%	4,59219%	0,32093	0,05776	3,46374%	9,38913%	0,36891	0,17506
All Announcements	0,03%									0,03510%	0,13515%	0,25973	-0,09757	0,45267%	0,54278%	0,83399	0,59557	0,83150%	0,97818%	0,85005	0,58687	1,69000%	2,20352%	0,76695	0,57310
	0,02%									0,06499%	0,13515%	0,48088	0,12359	0,48268%	0,54278%	0,88928	0,65086	0,86162%	0,97818%	0,88085	0,61767	1,72038%	2,20352%	0,78074	0,58689
	0,01%									0,09489%	0,13515%	0,70208	0,34478	0,51270%	0,54278%	0,94459	0,70617	0,89175%	0,97818%	0,91165	0,64848	1,75077%	2,20352%	0,79453	0,60068

Table 117: Impact of Macroeconomic Report Releases on US Government Bond Futures

(Bloomberg L.P., 2017, own graph)

2016-2017	Impact of US Macroeconomic Release on Short- and Long-Term US Treasury Futures on Announcement Day								
	Month-over-Month/Quarter-over-Quarter Change						Estimated	ED1 Comdty	TY1 Comdty
Announcement Date	Employment (in 1000s)	CPI (in %)	PPI (in %)	GDP Advance (in %)	Durable Goods Orders (in %)	Initial Jobless Claims (in %)	Effect on Future Price*	(Three-months Future)	(Ten-years Future)
31.12.2015	239	-0,1			-3,9	4	Positive	0,0001	0,0024
07.01.2016			-0,2				Positive	0,0002	0,0020
01.02.2016	126	0,1			3,7	0,4	Inconsistent	-0,020%	-0,320%
03.02.2016				0,5			Positive	0,000%	-0,061%
08.02.2016			-0,2				Positive	0,010%	0,722%
29.02.2016	237	-0,1			-3,3	-8,4	Inconsistent	0,015%	0,110%
09.03.2016			0,3				Negative	-0,015%	-0,332%
31.03.2016	225	0,1			2	5,3	Inconsistent	0,000%	0,281%
08.04.2016			0,2				Positive	-0,015%	-0,157%
02.05.2016	153	0,3			3,2	-0,7	Inconsistent	-0,010%	-0,281%
03.05.2016				1,2			Negative	0,030%	0,466%
09.05.2016			0,5				Negative	0,025%	0,207%
31.05.2016	43	0,2			-2,9	-2,2	Inconsistent	0,000%	-0,012%
08.06.2016			-0,1				Positive	0,005%	-0,036%
30.06.2016	297	0,2			-4,3	0,7	Inconsistent	0,015%	-0,048%
11.07.2016			-0,2				Positive	-0,030%	-0,487%
01.08.2016	291	0			3,6	-1,1	Inconsistent	-0,010%	-0,191%
02.08.2016				2,9			Negative	-0,020%	-0,191%
09.08.2016			0,3				Negative	-0,010%	0,217%
31.08.2016	176	0,2			0,2	-1,5	Inconsistent	0,000%	0,000%
07.09.2016			-0,1				Positive	-0,005%	0,000%
30.09.2016	249	0,3			0,3	-6,5	Negative	-0,005%	-0,312%
07.10.2016			0,5				Negative	0,000%	0,085%
31.10.2016	124	0,3			5	8,1	Inconsistent	0,005%	0,061%
02.11.2016				1,9			Positive	0,005%	0,182%
09.11.2016			0,2				Positive	0,015%	-1,145%
30.11.2016	164	0,2			-4,7	0,8	Inconsistent	-0,010%	-0,477%
09.12.2016			0,6				Negative	-0,015%	-0,403%
02.01.2017	157	0,3			-0,9	-11,6	Inconsistent	0,000%	0,000%
31.01.2017	227	0,6			2	4,6	Inconsistent	0,005%	0,202%

*based on all macroeconomic announcements made on that day and compared with the prior month-over-month or quarter-over-quarter change. Positive/Negative effects on the yields are expected only when on the same day all reports provide the same information on economic growth and/or inflation.

7.5.7. PCA Residuals Trading

Table 118: Results: PCA Residuals Trading - First Component Only before & after Transaction Costs - In- & Out-of-Sample (Bloomberg L.P., 2017, own graph)

US Market	PCA Residuals Trading - First Component Only														
	ED1 Comdty (Three-months Future)					TU1 Comdty (Two-years future)					FV1 Comdty (Five-years Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
02.01.2001 - 07.01.2003	-1,17551%	0,75917%	-1,54840	-4,4899019	1,000	-1,79569%	1,51980%	-1,18153	-3,1535115	0,964	4,99042%	3,18556%	1,56658	0,1923933	0,000
14.01.2003 - 12.01.2005	0,12637%	0,50086%	0,25231	0,1399694	1,000	0,56642%	1,17068%	0,48384	0,1221671	1,000	-0,35614%	1,74638%	-0,20393	-0,7234982	0,000
	TY1 Comdty (Ten-years Future)					US1 Comdty (Thirty-years Future)									
	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)					
	6,85466%	4,40177%	1,55725	0,4341817	0,007	3,30725%	5,98221%	0,55285	-0,0547637	0,400					
	1,50539%	4,59389%	0,32769	-0,1824116	0,446	-2,10686%	7,33742%	-0,28714	-0,7728146	0,724					

	PCA Residuals Trading - First Component Only (after Transaction Costs - 0,01% per Trade)							
	FV1 Comdty (Five-years Future)				TY1 Comdty (Ten-years Future)			
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
02.01.2001 - 07.01.2003	4,93897%	3,18556%	1,55043	0,1762449	6,78690%	4,40177%	1,54186	0,4187879
	after 0,02% per Trade							
	4,88755%	3,18556%	1,53428	0,1601027	6,71917%	4,40177%	1,52647	0,4034023
	after 0,03% per Trade							
	4,83615%	3,18556%	1,51815	0,1439668	6,65149%	4,40177%	1,51109	0,3880248

	PCA Residuals Trading - First Component Only (after Transaction Costs - 0,01% per Trade)							
	ED1 Comdty (Three-months Future)				TU1 Comdty (Two-years future)			
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
14.01.2003 - 12.01.2005	0,06667%	0,50086%	0,13311	0,0207635	0,52644%	1,17068%	0,44969	0,0880151
	after 0,02% per Trade							
	0,00699%	0,50086%	0,01396	-0,0983840	0,48647%	1,17068%	0,41555	0,0538730
	after 0,03% per Trade							
	-0,05266%	0,50086%	-0,10513	-0,2174731	0,44651%	1,17068%	0,38142	0,0197410

Table 119: Results: PCA Residuals Trading - First Two Components before & after Transaction Costs - In- & Out-of-Sample (Bloomberg L.P., 2017, own graph)

US Market

	PCA Residuals Trading - First Two Components (before Transaction Costs)														
	ED1 Comdty (Three-months Future)					TU1 Comdty (Two-years future)					FV1 Comdty (Five-years Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
02.01.2001 - 07.01.2003	0,80756%	0,73233%	1,10273	-1,8387676	0,478	1,76090%	0,99323%	1,77289	-0,1990891	0,796	3,79349%	2,31171%	1,64099	0,2668059	0,330
14.01.2003 - 12.01.2005	0,22710%	0,46759%	0,48567	0,3733320	0,000	0,97183%	1,25110%	0,77678	0,4151042	0,005	-0,13895%	2,97335%	-0,04673	-0,5662968	0,257
	TY1 Comdty (Ten-years Future)					US1 Comdty (Thirty-years Future)									
	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)					
	1,64853%	3,49240%	0,47203	-0,6510333	0,029	-4,88803%	5,44176%	-0,89824	-1,5058548	0,574					
	-1,89007%	5,42086%	-0,34867	-0,8587714	0,554	0,00000%	7,43107%	0,00000	-0,0065155	0,720					

	PCA Residuals Trading - First Two Components (after Transaction Costs - 0,01% per Trade)			
	FV1 Comdty (Five-years Future)			
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
02.01.2001 - 07.01.2003	3,76822%	2,3117%	1,63006	0,25587
	after 0,02% per Trade			
	3,74295%	2,3117%	1,61913	0,24494
	after 0,03% per Trade			
	3,71768%	2,3117%	1,60820	0,23401

	PCA Residuals Trading - First Two Components (after Transaction Costs - 0,01% per Trade)							
	ED1 Comdty (Three-months Future)				TU1 Comdty (Two-years future)			
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR
14.01.2003 - 12.01.2005	0,18725%	0,46759%	0,40046	0,2881143	0,91163%	1,25110%	0,72866	0,3669833
	after 0,02% per Trade							
	0,14741%	0,46759%	0,31526	0,2029216	0,85145%	1,25110%	0,68056	0,3188861
	after 0,03% per Trade							
	0,10759%	0,46759%	0,23010	0,1177539	0,79131%	1,25110%	0,63249	0,2708124

Table 120: Results: PCA Residuals Trading - First Three Components before Transaction Costs - In- & Out-of-Sample (Bloomberg L.P., 2017, own graph)

US Market	**PCA Residuals Trading - First Three Components (before Transaction Costs)**														
	ED1 Comdty (Three-months Future)					TU1 Comdty (Two-years future)					FV1 Comdty (Five-years Future)				
Period	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
02.01.2001 - 07.01.2003	1,06371%	0,80587%	1,31996	-1,6215364	0,646	2,15601%	1,68479%	1,27969	-0,6922939	0,000	2,02138%	2,75211%	0,73448	-0,6396987	0,403
14.01.2003 - 12.01.2005	-0,19103%	0,57255%	-0,33364	-0,4459843	0,513	-0,00194%	1,11059%	-0,00175	-0,3634259	0,106	0,66868%	2,62581%	0,25466	-0,2649105	0,529

	TY1 Comdty (Ten-years Future)					US1 Comdty (Thirty-years Future)				
	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)	Annualized Performance	Annualized Volatility	Annualized Sharpe Ratio	Excess SR	p-value (RC)
	0,74514%	4,88841%	0,15243	-0,9706382	0,133	-1,39604%	6,74803%	-0,20688	-0,8144935	0,000
	1,60893%	4,70730%	0,34179	-0,1683118	0,345	-8,27500%	7,01488%	-1,17963	-1,6653107	0,724

7.6. Factor-based Scenario Method

Based on the PCA outputs from March 3, 2017 and the first four observation days, it is illustrated how it has been proceeded to create the factor-based scenario analysis. From the output of the PCA run through SPSS, the component and component score matrices are of particular importance. For the scenario construction, just the first two components were extracted. All other components were neglected from the beginning on. The component matrix includes the loadings of each component. The loading is nothing else as the determining power of the component on the variables examined. In this case, the variables are the yield changes. The loadings have sizes ranging between -1 and +1. While the former indicates that the component influences the yield change highly negatively, the second indicates that a change in the yield is highly positively influenced by the component. On the other hand, a loading of zero means that the component may have no explanatory power at all. Table 121 illustrates the component loadings as of observation day March 3, 2017 for US treasury rates:

Table 121: PCA Component Matrix as of 03.03.2017 on US Treasury Rates
(Bloomberg L.P., 2017, own SPSS output)

Component Matrix[a]

	Component	
	1	2
US_Overnight	,125	,788
US_3_months	,211	,628
US_2_years	,901	-,060
US_5_years	,984	-,041
US_10_years	,986	-,051
US_30_years	,915	-,095

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

While the loadings illustrate to what extent changes in the yields are explained by either the level or the slope, the component scores are rather transformed yield changes based on the original value and the component loading (NCSS, n.d., p. 1). The component score coefficient matrix is needed for many observations in order to figure out the standard deviation of the components. The standard deviation of a PC is the result of linearly combining each variable's score volatility, which in turn is computed over 110 observation days. For instance, the standard deviation of PC1 is computed by first calculating the volatility of each treasury rate's PC1 score over the 110 observations and second adding the volatilities computed for each treasury rate. This is illustrated by table 122. Latter shows on the left the scores of PC1 and PC2 for the US overnight rate over the first four and the last observation. On the right, it rather presents the standard deviation of each PC for all rates over all 110 observations made. In this example, the component scores amount to 0,002 on October 3, 2016, 0,002 on October 4, 2016 and so on. On

the other side, the value 0,007 equals the standard deviation (in %) of PC1 for the US overnight rate based on all 110 scores observed from October 3, 2016 to March 3, 2017.

Table 122: PCA Component Score Coefficients of First Four and Last Observation on US Overnight Rate & Components' Standard Deviations for All US Treasury Rates (Bloomberg L.P., 2017, own graph)

	US Overnight Rate			All US Treasury Rates	
	Component			Component Score Standard Deviation*	
	1	2		1	2
03.10.2016	0,002	0,692	US_Overnight	0,007	0,054
04.10.2016	0,002	0,693	US_3_months	0,010	0,074
05.10.2016	0,000	0,696	US_2_years	0,001	0,009
06.10.2016	0,001	0,695	US_5_years	0,001	0,008
…	…		US_10_years	0,000	0,012
03.03.2017	-0,017	0,751	US_30_years	0,001	0,006
*the component score standard deviation is calculated for every rate over all 110 observation points			Component Standard Deviation	0,020	0,163
				in bps	
				2,017	16,301

The factors level and slope for each point on the yield curve are then the product of the component's standard deviation and the component's loading of the respective rate (Frye, 1997, p. 9). For the component "level", again based on the US overnight rate, the factor level would result in: 2,017 bps * 0,125 = 0,251 bps. Note that the loading of 0,125 is taken from table 121. Once the factors are computed for all points on the yield curve, the scenarios can be built. Under scenario 1, which implies a negative shock on the level, while the slope of the yield curve remaining equal, the US overnight rate would newly be the product of 0,251 bps and the quantile's z-value. Therefore, when applying a quantile of 51% (= 0,025 std. devs.) or 75% (= 0,674 std. devs.), the US overnight rate would decrease by 0,0063 bps (= -0,251 * 0,025) and by 0,1694bps (= -0,251 * 0,674) respectively.

7.7. Scenarios

Table 123: Simulated US Yield Changes in bps (Bloomberg L.P., 2017, own graph)

US Yield Changes (in bps)													
Shock on PC1		**Scenario 1**						**Scenario 2**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	-0,0063	-0,0107	-0,0456	-0,0497	-0,0498	-0,0462	0,0063	0,0107	0,0456	0,0497	0,0498	0,0462
75%	0,674	-0,1694	-0,2871	-1,2258	-1,3380	-1,3406	-1,2440	0,1694	0,2871	1,2258	1,3380	1,3406	1,2440
		Scenario 3											
95%	1,645	0,4130	0,7002	2,9893	3,2629	3,2692	3,0337						
99%	2,326	0,5841	0,9904	4,2278	4,6148	4,6237	4,2906						
99,90%	3,090	0,7759	1,3156	5,6160	6,1301	6,1419	5,6995						
99,997%	4,000	1,0044	1,7029	7,2694	7,9348	7,9501	7,3775						
100%	6,000	1,5066	2,5543	10,9041	11,9022	11,9252	11,0662						
Shock on PC2		**Scenario 4**						**Scenario 5**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	-0,3218	-0,2566	0,0245	0,0166	0,0207	0,0388	0,3218	0,2566	-0,0245	-0,0166	-0,0207	-0,0388
75%	0,674	-8,6591	-6,9028	0,6579	0,4460	0,5578	1,0431	8,6591	6,9028	-0,6579	-0,4460	-0,5578	-1,0431
		Scenario 6											
95%	1,645	21,1165	16,8336	-1,6045	-1,0875	-1,3603	-2,5437						
99%	2,326	29,8655	23,8081	-2,2693	-1,5381	-1,9240	-3,5976						
99,90%	3,090	39,6722	31,6257	-3,0144	-2,0432	-2,5557	-4,7790						
99,997%	4,000	51,3517	40,9364	-3,9019	-2,6447	-3,3081	-6,1859						
100%	6,000	77,0276	61,4046	-5,8528	-3,9670	-4,9622	-9,2788						
Shock on PC1 & PC2		**Scenario 7**						**Scenario 8**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	0,3155	0,2459	-0,0700	-0,0663	-0,0706	-0,0850	0,3281	0,2672	0,0211	0,0332	0,0291	0,0075
75%	0,674	8,4897	6,6156	-1,8837	-1,7839	-1,8984	-2,2871	8,8284	7,1899	0,5678	0,8920	0,7827	0,2009
		Scenario 9											
95%	1,645	21,5295	17,5338	1,3848	2,1754	1,9088	0,4900						
99%	2,326	30,4496	24,7984	1,9585	3,0767	2,6997	0,6930						
99,90%	3,090	40,4481	32,9413	2,6016	4,0869	3,5862	0,9206						
99,997%	4,000	52,3561	42,6393	3,3675	5,2901	4,6420	1,1916						
100%	6,000	78,5342	63,9589	5,0512	7,9352	6,9630	1,7874						
Shock on PC1 & PC2		**Scenario 10**						**Scenario 11**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	-0,3281	-0,2672	-0,0211	-0,0332	-0,0291	-0,0075	-0,3155	-0,2459	0,0700	0,0663	0,0706	0,0850
75%	0,674	-8,8284	-7,1899	-0,5678	-0,8920	-0,7827	-0,2009	-8,4897	-6,6156	1,8837	1,7839	1,8984	2,2871
		Scenario 12											
95%	1,645	-20,7035	-16,1333	4,5938	4,3504	4,6295	5,5774						
99%	2,326	-29,2814	-22,8177	6,4971	6,1529	6,5477	7,8883						
99,90%	3,090	-38,8963	-30,3102	8,6305	8,1733	8,6977	10,4785						
99,997%	4,000	-50,3474	-39,2335	11,1713	10,5795	11,2583	13,5634						
100%	6,000	-75,5211	-58,8502	16,7569	15,8692	16,8874	20,3450						

Simulated US Yield Curve													
Shock on PC1		**Scenario 1**						**Scenario 2**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	0,6599	1,1016	1,3046	2,0085	2,4775	3,0708	0,6601	1,1018	1,3056	2,0095	2,4785	3,0718
75%	0,674	0,6583	1,0988	1,2928	1,9956	2,4646	3,0589	0,6617	1,1045	1,3174	2,0224	2,4914	3,0837
		Scenario 3											
95%	1,645	0,6641	1,1087	1,3350	2,0416	2,5107	3,1016						
99%	2,326	0,6658	1,1116	1,3474	2,0551	2,5242	3,1142						
99,90%	3,090	0,6678	1,1148	1,3613	2,0703	2,5394	3,1283						
99,997%	4,000	0,6700	1,1187	1,3778	2,0883	2,5575	3,1451						
100%	6,000	0,6751	1,1272	1,4141	2,1280	2,5973	3,1820						

Shock on PC1		**Scenario 4**						**Scenario 5**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	0,6568	1,0991	1,3053	2,0092	2,4782	3,0717	0,6632	1,1042	1,3049	2,0088	2,4778	3,0709
75%	0,674	0,5734	1,0326	1,3117	2,0135	2,4836	3,0817	0,7466	1,1707	1,2985	2,0045	2,4724	3,0609
		Scenario 6											
95%	1,645	0,8712	1,2700	1,2891	1,9981	2,4644	3,0459						
99%	2,326	0,9587	1,3398	1,2824	1,9936	2,4588	3,0353						
99,90%	3,090	1,0567	1,4179	1,2750	1,9886	2,4524	3,0235						
99,997%	4,000	1,1735	1,5110	1,2661	1,9826	2,4449	3,0094						
100%	6,000	1,4303	1,7157	1,2466	1,9693	2,4284	2,9785						

Shock on PC1 & PC2		**Scenario 7**						**Scenario 8**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	0,6632	1,1041	1,3044	2,0083	2,4773	3,0704	0,6633	1,1043	1,3053	2,0093	2,4783	3,0714
75%	0,674	0,7449	1,1678	1,2863	1,9912	2,4590	3,0484	0,7483	1,1736	1,3108	2,0179	2,4858	3,0733
		Scenario 9											
95%	1,645	0,8753	1,2770	1,3189	2,0308	2,4971	3,0762						
99%	2,326	0,9645	1,3497	1,3247	2,0398	2,5050	3,0782						
99,90%	3,090	1,0645	1,4311	1,3311	2,0499	2,5139	3,0805						
99,997%	4,000	1,1836	1,5281	1,3388	2,0619	2,5244	3,0832						
100%	6,000	1,4453	1,7413	1,3556	2,0884	2,5476	3,0892						

Shock on PC1 & PC2		**Scenario 10**						**Scenario 11**					
Quantile	Std. dev.	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years	US_Overnight	US_3_months	US_2_years	US_5_years	US_10_years	US_30_years
51%	0,025	0,6567	1,0990	1,3049	2,0087	2,4777	3,0712	0,6568	1,0992	1,3058	2,0097	2,4787	3,0722
75%	0,674	0,5717	1,0298	1,2994	2,0001	2,4702	3,0693	0,5751	1,0355	1,3239	2,0268	2,4970	3,0942
		Scenario 12											
95%	1,645	0,4530	0,9403	1,3510	2,0525	2,5243	3,1271						
99%	2,326	0,3672	0,8735	1,3701	2,0705	2,5435	3,1502						
99,90%	3,090	0,2710	0,7986	1,3914	2,0907	2,5650	3,1761						
99,997%	4,000	0,1565	0,7093	1,4168	2,1148	2,5906	3,2069						
100%	6,000	-0,0952	0,5132	1,4727	2,1677	2,6469	3,2748						

Table 124: Simulated US Yield Curves (Bloomberg L.P., 2017, own graph)

Table 125: Simulated German Yield Changes in bps (Bloomberg L.P., 2017, own graph)

German Yield Changes (in bps)													
Shock on PC1		**Scenario 1**						**Scenario 2**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	0,0248	-0,0701	-0,2732	-0,3274	-0,3295	-0,3127	-0,0248	0,0701	0,2732	0,3274	0,3295	0,3127
75%	0,674	0,6666	-1,8865	-7,3503	-8,8101	-8,8642	-8,4132	-0,6666	1,8865	7,3503	8,8101	8,8642	8,4132
		Scenario 3											
95%	1,645	-1,6256	4,6006	17,9248	21,4848	21,6168	20,5170						
99%	2,326	-2,2991	6,5067	25,3514	30,3863	30,5730	29,0176						
99,90%	3,090	-3,0540	8,6433	33,6759	40,3640	40,6120	38,5458						
99,997%	4,000	-3,9531	11,1878	43,5901	52,2473	52,5683	49,8938						
100%	6,000	-5,9297	16,7817	65,3851	78,3709	78,8524	74,8407						
Shock on PC2		**Scenario 4**						**Scenario 5**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	-2,0647	1,4635	-0,0477	-0,2482	-0,1510	-0,0310	2,0647	-1,4635	0,0477	0,2482	0,1510	0,0310
75%	0,674	-55,5506	39,3759	-1,2829	-6,6792	-4,0634	-0,8343	55,5506	-39,3759	1,2829	6,6792	4,0634	0,8343
		Scenario 6											
95%	1,645	135,4693	-96,0246	3,1287	16,2883	9,9094	2,0347						
99%	2,326	191,5968	-135,8094	4,4249	23,0369	14,0150	2,8777						
99,90%	3,090	254,5099	-180,4041	5,8779	30,6013	18,6170	3,8226						
99,997%	4,000	329,4379	-233,5153	7,6084	39,6104	24,0979	4,9480						
100%	6,000	494,1568	-350,2729	11,4125	59,4155	36,1468	7,4220						
Shock on PC1 & PC2		**Scenario 7**						**Scenario 8**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	2,0894	-1,5336	-0,2255	-0,0792	-0,1784	-0,2817	2,0399	-1,3934	0,3209	0,5757	0,4805	0,3437
75%	0,674	56,2172	-41,2624	-6,0673	-2,1309	-4,8007	-7,5789	54,8840	-37,4894	8,6332	15,4893	12,9276	9,2475
		Scenario 9											
95%	1,645	133,8437	-91,4240	21,0535	37,7731	31,5262	22,5517						
99%	2,326	189,2977	-129,3027	29,7764	53,4232	44,5880	31,8952						
99,90%	3,090	251,4559	-171,7609	39,5538	70,9654	59,2291	42,3684						
99,997%	4,000	325,4848	-222,3274	51,1984	91,8576	76,6662	54,8417						
100%	6,000	488,2271	-333,4912	76,7977	137,7865	114,9992	82,2626						
Shock on PC1 & PC2		**Scenario 10**						**Scenario 11**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	-2,0399	1,3934	-0,3209	-0,5757	-0,4805	-0,3437	-2,0894	1,5336	0,2255	0,0792	0,1784	0,2817
75%	0,674	-54,8840	37,4894	-8,6332	-15,4893	-12,9276	-9,2475	-56,2172	41,2624	6,0673	2,1309	4,8007	7,5789
		Scenario 12											
95%	1,645	-137,0949	100,6252	14,7962	5,1965	11,7074	18,4823						
99%	2,326	-193,8959	142,3161	20,9265	7,3495	16,5580	26,1399						
99,90%	3,090	-257,5639	189,0474	27,7980	9,7627	21,9950	34,7232						
99,997%	4,000	-333,3910	244,7031	35,9817	12,6369	28,4704	44,9458						
100%	6,000	-500,0865	367,0547	53,9726	18,9554	42,7056	67,4187						

Table 126: Simulated German Yield Curves (Bloomberg L.P., 2017, own graph)

Simulated German Yield Curve													
Shock on PC1		**Scenario 1**						**Scenario 2**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	-0,3488	-0,3297	-0,8027	-0,4203	0,3527	1,1459	-0,3492	-0,3283	-0,7973	-0,4137	0,3593	1,1521
75%	0,674	-0,3423	-0,3479	-0,8735	-0,5051	0,2674	1,0649	-0,3557	-0,3101	-0,7265	-0,3289	0,4446	1,2331
		Scenario 3											
95%	1,645	-0,3653	-0,2830	-0,6208	-0,2022	0,5722	1,3542						
99%	2,326	-0,3720	-0,2639	-0,5465	-0,1131	0,6617	1,4392						
99,90%	3,090	-0,3795	-0,2426	-0,4632	-0,0134	0,7621	1,5345						
99,997%	4,000	-0,3885	-0,2171	-0,3641	0,1055	0,8817	1,6479						
100%	6,000	-0,4083	-0,1612	-0,1461	0,3667	1,1445	1,8974						
Shock on PC1		**Scenario 4**						**Scenario 5**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	-0,3696	-0,3144	-0,8005	-0,4195	0,3545	1,1487	-0,3284	-0,3436	-0,7995	-0,4145	0,3575	1,1493
75%	0,674	-0,9045	0,0648	-0,8128	-0,4838	0,3154	1,1407	0,2065	-0,7228	-0,7872	-0,3502	0,3966	1,1573
		Scenario 6											
95%	1,645	1,0057	-1,2892	-0,7687	-0,2541	0,4551	1,1693						
99%	2,326	1,5670	-1,6871	-0,7558	-0,1866	0,4962	1,1778						
99,90%	3,090	2,1961	-2,1330	-0,7412	-0,1110	0,5422	1,1872						
99,997%	4,000	2,9454	-2,6642	-0,7239	-0,0209	0,5970	1,1985						
100%	6,000	4,5926	-3,8317	-0,6859	0,1772	0,7175	1,2232						
Shock on PC1 & PC2		**Scenario 7**						**Scenario 8**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	-0,3281	-0,3443	-0,8023	-0,4178	0,3542	1,1462	-0,3286	-0,3429	-0,7968	-0,4112	0,3608	1,1524
75%	0,674	0,2132	-0,7416	-0,8607	-0,4383	0,3080	1,0732	0,1998	-0,7039	-0,7137	-0,2621	0,4853	1,2415
		Scenario 9											
95%	1,645	0,9894	-1,2432	-0,5895	-0,0393	0,6713	1,3745						
99%	2,326	1,5440	-1,6220	-0,5022	0,1172	0,8019	1,4680						
99,90%	3,090	2,1656	-2,0466	-0,4045	0,2927	0,9483	1,5727						
99,997%	4,000	2,9058	-2,5523	-0,2880	0,5016	1,1227	1,6974						
100%	6,000	4,5333	-3,6639	-0,0320	0,9609	1,5060	1,9716						
Shock on PC1 & PC2		**Scenario 10**						**Scenario 11**					
Quantile	Std. dev.	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years	EONIA	EUR_3_months	GER_2_years	GER_5_years	GER_10_years	GER_30_years
51%	0,025	-0,3694	-0,3151	-0,8032	-0,4228	0,3512	1,1456	-0,3699	-0,3137	-0,7977	-0,4162	0,3578	1,1518
75%	0,674	-0,8978	0,0459	-0,8863	-0,5719	0,2267	1,0565	-0,9112	0,0836	-0,7393	-0,3957	0,4040	1,2248
		Scenario 12											
95%	1,645	-1,7199	0,6773	-0,6520	-0,3650	0,4731	1,3338						
99%	2,326	-2,2880	1,0942	-0,5907	-0,3435	0,5216	1,4104						
99,90%	3,090	-2,9246	1,5615	-0,5220	-0,3194	0,5760	1,4962						
99,997%	4,000	-3,6829	2,1180	-0,4402	-0,2906	0,6407	1,5985						
100%	6,000	-5,3499	3,3415	-0,2603	-0,2274	0,7831	1,8232						

Table 127: Factors Level and Slope for US Yield Curve (Bloomberg L.P., 2017, own graph)

	Component Score Standard Deviation		Component Matrix as of 03.03.2017		Yield Change (in bps)*	
	Component		Component		Component	
	1	2	1	2	1	2
US_Overnight	0,007	0,054	0,125	0,788	0,251	12,838
US_3_months	0,010	0,074	0,211	0,628	0,426	10,234
US_2_years	0,001	0,009	0,901	-0,060	1,817	-0,975
US_5_years	0,001	0,008	0,984	-0,041	1,984	-0,661
US_10_years	0,000	0,012	0,986	-0,051	1,988	-0,827
US_30_years	0,001	0,006	0,915	-0,095	1,844	-1,546
Component Standard Deviation	0,020	0,163				
	in bps					
	2,017	16,301				

* For US_Overnight;
PC1 = 2,017 * 0,125 = 0,251
PC2 = 16,301 * 0,788 = 12,838

Table 128: Factors Level and Slope for German Yield Curve (Bloomberg L.P., 2017, own graph)

	Component Score Standard Deviation		Component Matrix as of 03.03.2017		Yield Change (in bps)*	
	Component		Component		Component	
	1	2	1	2	1	2
EONIA	0,018	0,175	-0,071	0,816	-0,988	82,359
EUR_3_months	0,013	0,666	0,202	-0,579	2,797	-58,379
GER_2_years	0,025	0,050	0,787	0,019	10,898	1,902
GER_5_years	0,028	0,038	0,943	0,098	13,062	9,903
GER_10_years	0,028	0,018	0,949	0,060	13,142	6,024
GER_30_years	0,027	0,062	0,900	0,012	12,473	1,237
Component Standard Deviation	0,139	1,009				
	in bps					
	13,853	100,893				

* For EONIA;
PC1 = 13,853 * -0,071 = -0,988
PC2 = 100,893 * 0,816 = 82,36

Figure 1: US Yield Curve Scenarios 1 to 3 (Bloomberg L.P., 2017, own graph)

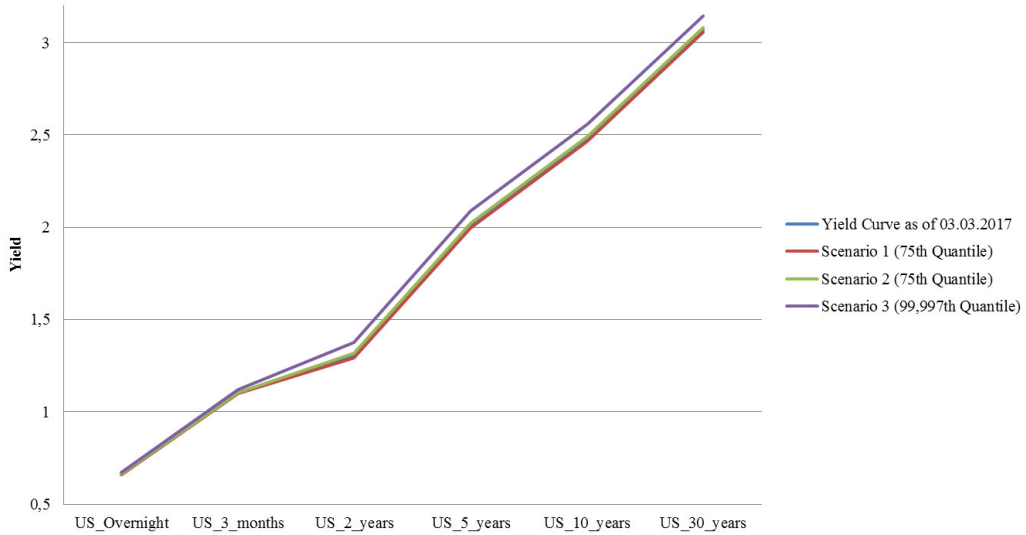


Figure 2: US Yield Curve Scenarios 4 to 6 (Bloomberg L.P., 2017, own graph)

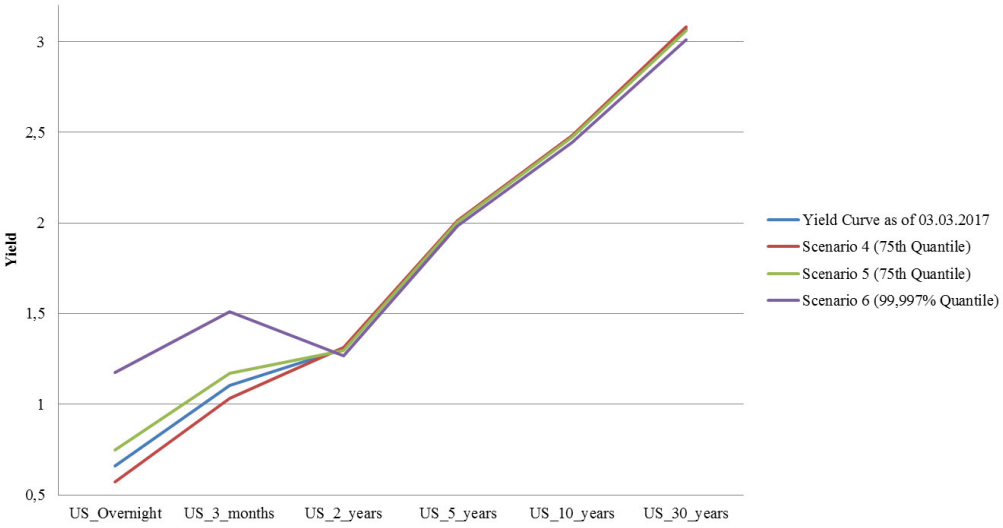


Figure 12: US Yield Curve Scenarios 7 to 9 (Bloomberg L.P., 2017, own graph)

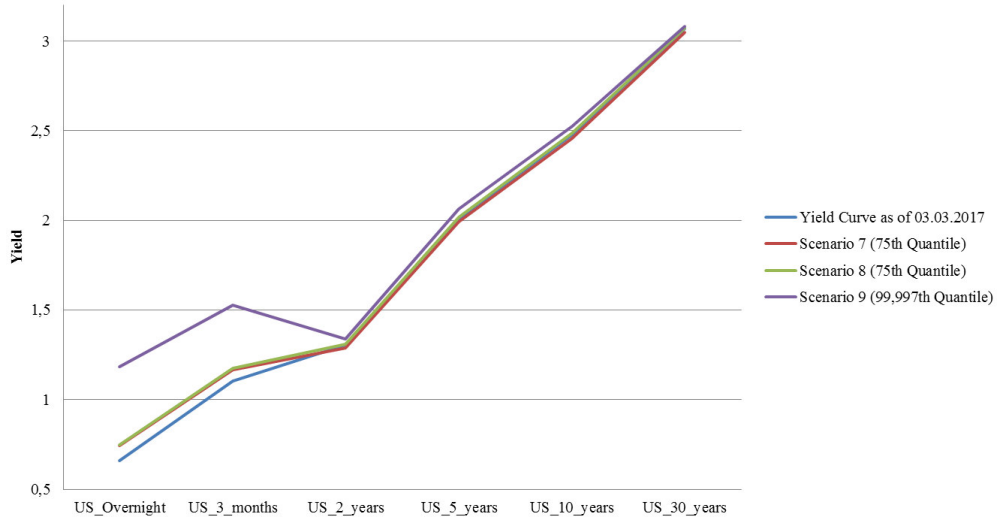


Figure 13: US Yield Curve Scenarios 10 to 12 (Bloomberg L.P., 2017, own graph)

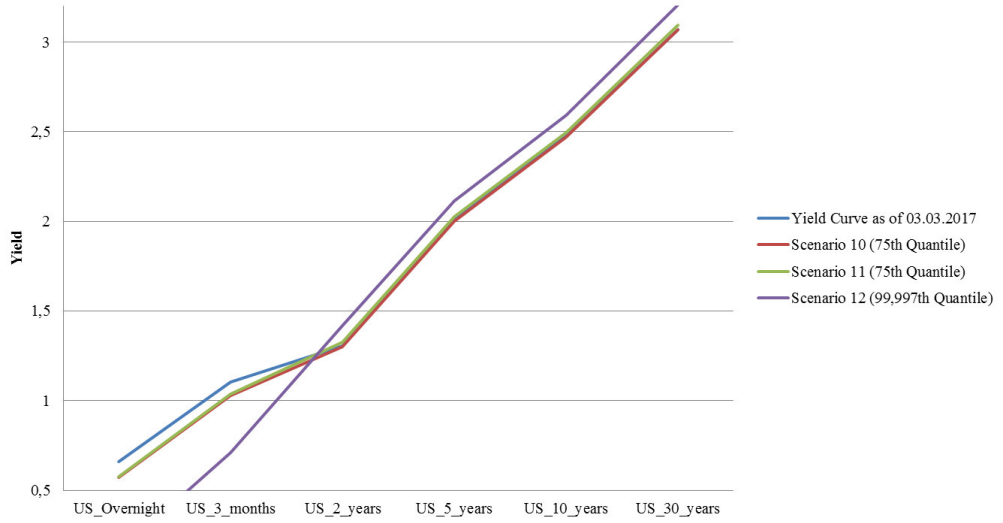


Figure 14: German Yield Curve Scenarios 1 to 3 (Bloomberg L.P., 2017, own graph)

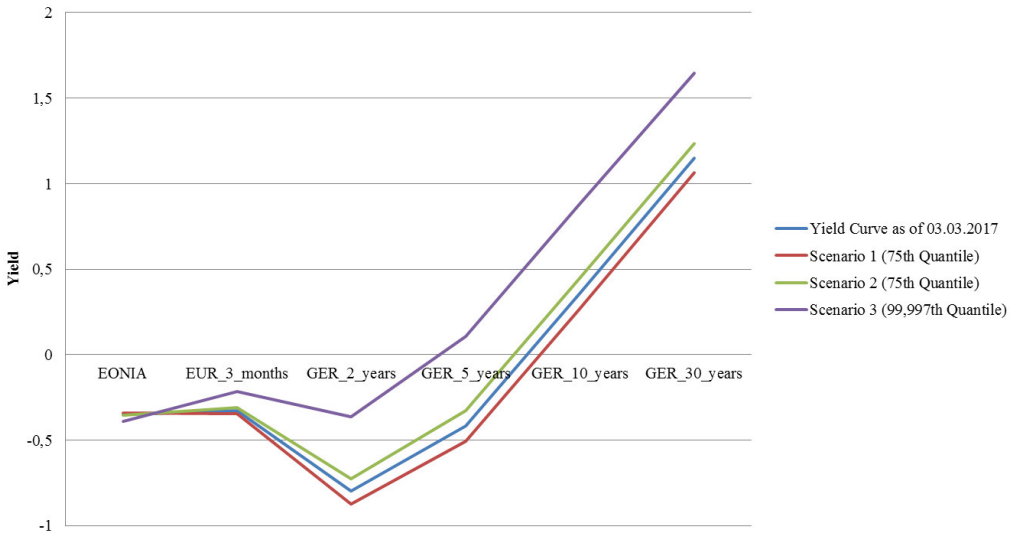


Figure 15: German Yield Curve Scenarios 4 to 6 (Bloomberg L.P., 2017, own graph)

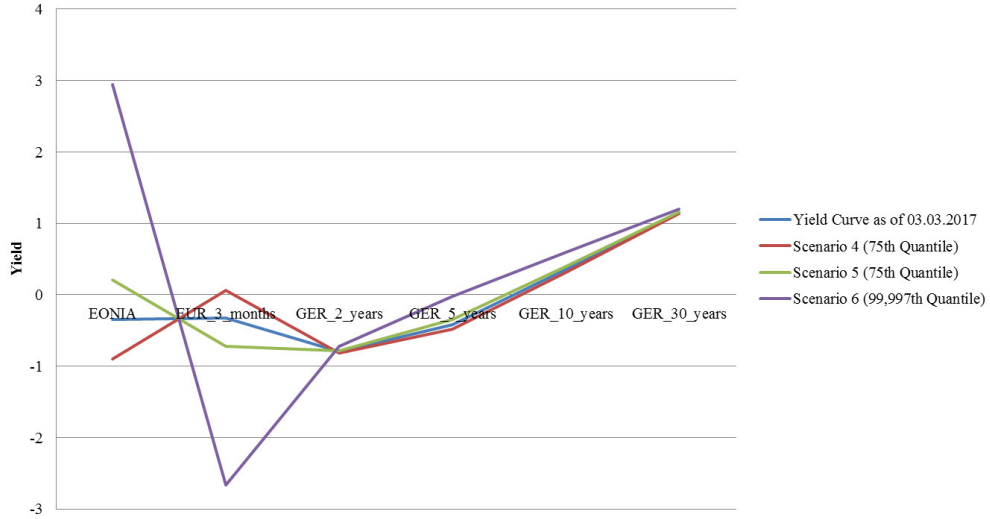


Figure 16: German Yield Curve Scenarios 7 to 9 (Bloomberg L.P., 2017, own graph)

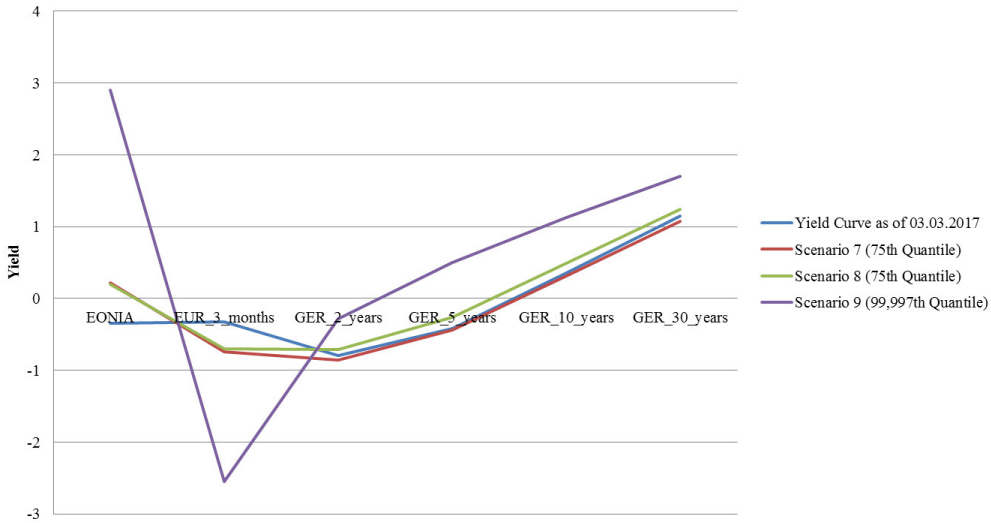
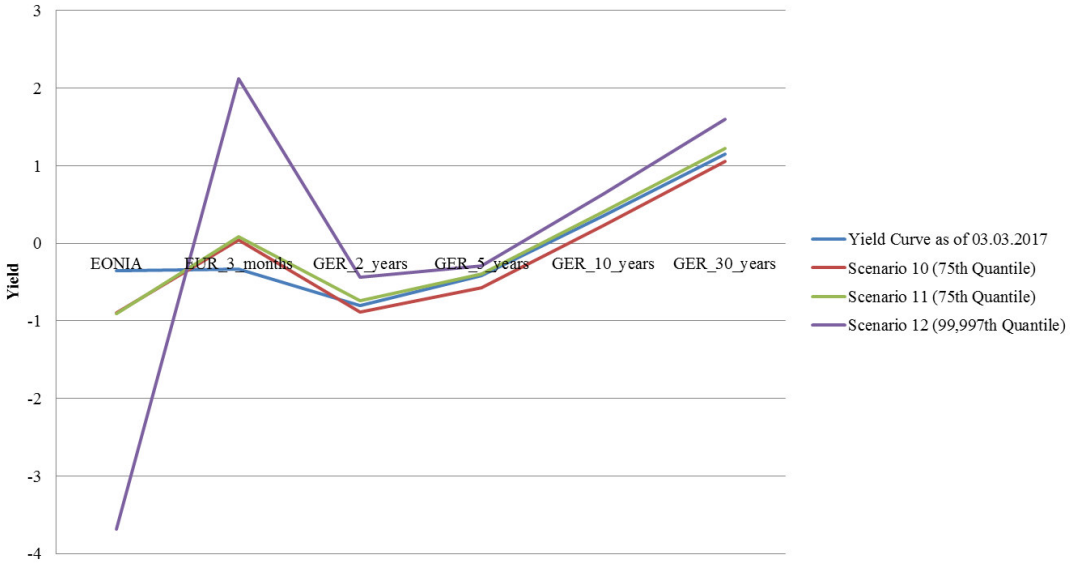


Figure 17: German Yield Curve Scenarios 10 to 12 (Bloomberg L.P., 2017, own graph)



7.7.1. Portfolio Sensitivities

Table 129: Sensitivities of TSC, 2. CSC and B&H - all Scenarios (Bloomberg L.P., 2017, own graph)

03.03.2017		Portfolio Impact of Changes in US and German Yield Curve on TSC Portfolio (in %)											
		Scenarios											
Quantile	Std. dev.	1	2	3	4	5	6	7	8	9	10	11	12
51%	0,03	0,0163%	-0,0162%		0,0008%	-0,0008%		0,0158%	-0,0167%		0,0167%	-0,0158%	
75%	0,67	0,4397%	-0,4346%		0,0117%	-0,0115%		0,4276%	-0,4455%		0,4520%	-0,4235%	
95%	1,64			-1,0510%			-0,0278%			-1,0754%			-1,0257%
99%	2,33			-1,4779%			-0,0391%			-1,5102%			-1,4438%
99,90%	3,09			-1,9506%			-0,0515%			-1,9904%			-1,9078%
99,997%	4,00			-2,5060%			-0,0660%			-2,5527%			-2,4542%
100%	6,00			-3,6989%			-0,0969%			-3,7542%			-3,6326%
Quantile	Std. dev.	Impact on 2. CSC Portfolio											
51%	0,03	0,0001%	-0,0001%		0,0038%	-0,0038%		-0,0037%	-0,0039%		0,0039%	0,0037%	
75%	0,67	0,0026%	-0,0026%		0,1020%	-0,1022%		-0,0993%	-0,1048%		0,1046%	0,0994%	
95%	1,64			-0,0065%			-0,2485%			-0,2551%			0,2425%
99%	2,33			-0,0092%			-0,3514%			-0,3607%			0,3431%
99,90%	3,09			-0,0122%			-0,4666%			-0,4791%			0,4559%
99,997%	4,00			-0,0158%			-0,6038%			-0,6200%			0,5904%
100%	6,00			-0,0239%			-0,9049%			-0,9297%			0,8865%
Quantile	Std. dev.	Impact on Buy-and-Hold Portfolio											
51%	0,03	0,0238%	-0,0238%		0,0040%	-0,0041%		0,0201%	-0,0275%		0,0275%	-0,0201%	
75%	0,67	0,6436%	-0,6380%		0,0995%	-0,0991%		0,5436%	-0,7362%		0,7440%	-0,5394%	
95%	1,64			-1,5464%			-0,2411%			-1,7823%			-1,3083%
99%	2,33			-2,1777%			-0,3403%			-2,5079%			-1,8433%
99,90%	3,09			-2,8792%			-0,4511%			-3,3126%			-2,4383%
99,997%	4,00			-3,7062%			-0,5824%			-4,2594%			-3,1407%
100%	6,00			-5,4934%			-0,8688%			-6,2987%			-4,6613%

*Standard deviations are rounded up to two decimal places